

INJECTION TREATMENT IN
GENERAL PRACTICE.

INJECTION TREATMENT IN GENERAL PRACTICE

BY

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FOREWORD

WHEN there are already so many medical books dealing with almost every variety of knowledge that the student, the practitioner and the specialist requires, there must be good reason shown for the addition of yet another book to the medical library. A study of Dr. Gujral's small work shows that there is good reason for this new publication, for the book fulfils a need that many practitioners must have felt. This book is original in that it collects together for the first time, so far as I am aware, many modern methods of treatment by injection, giving a careful description of the technique and solution employed in the various injections. The average practitioner will surely find much that is new to him here, while every one will be glad to have this varied information arranged so succinctly, instead of having to hunt it up in several books and then not always with success. Medical practitioners probably spend a good deal of time searching for references or for some formula or description of technique that they remember to have seen somewhere. Here is the information they require about injections with a brief account of indications, contra-indications and possible complications, as up to date and as lucid as one could wish. This should be a welcome book for the busy general practitioner, physician and surgeon.

*New Delhi,
20th March, 1934.*

C. A. SPRAWSON.

P R E F A C E .

IN writing this little book it has been my endeavour to outline concisely yet lucidly, for the general practitioner a number of procedures which he is very frequently called upon to perform in the course of his every day practice. A number of obviously unallied conditions whose only bond is the injection needle, have been brought together for the simple reason that they are mentioned but not described in textbooks.

My apology for giving what may appear to be a sketchy description of therapeutic pneumothorax is, that it is best learnt by observing a physician versed in its technique, perform it. Considerations of space have a few other times compelled me to brevity.

I wish to express my indebtedness to Mayer, Blanchard, Morley, Terrel, Levy, McPheeters, Rice Bray, Burrell and numerous other writers to whose works I have had to refer from time to time, My thanks are also due to Messrs. Allen and Hanburys who kindly lent me the use of a number of blocks.

*Egerton Road,
Delhi.*

M. L. GUJRAL.

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INJECTION TREATMENT IN GENERAL PRACTICE.

CHAPTER I.

HERNIA.

INTRODUCTORY.

Treatment of hernia by injections has been a great success both in America and in Spain. Outside these two countries it has not so far received the consideration it deserves. Mayer of Detroit has employed the subcutaneous injection method in more than 2100 cases of inguinal, femoral and umbilical hernias. There was no recurrence for a period of years in 98 percent of his cases. Mayer's work covers a period of approximately thirty years. The Spanish surgeon Mestre using a different solution is said to have treated ten thousand cases. The method

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may be employed in cases of hernia recurring after a surgical operation.

Three types of treatment are at present in vogue; first, the so called radical "cure"; second, the use of a truss for the rest of the patient's life; and third, the injection method.

THE RADICAL CURE.

Let me here quote Mayer at some length. "Radical cure is the procedure almost invariably advocated in surgical circles, and impressive statistical results are generally reported. To one who has made a close study of hernia, however, it is apparent that these statistics are often misleading. It has been my experience to treat many patients with recurrent hernias, who had been classified by prominent surgeons as "cured," if the patient did not return for another operation. As a matter of fact, it should be obvious that one who has had an unsuccessful operation is not

likely to come back and take an other chance. The proper procedure in a follow up study of surgical results, therefore, would be to classify as "apparent cures" only those patients who have lived vigorous lives for several years after the hernia operations and, on careful physical examination, show no evidence of a return of the hernial protrusion under stress. Based on a scientific study such as this, the figures for "cure" of hernia by operation would be comparatively modest."

"The great majority of persons afflicted with a hernia wear a truss. Only a minority come for surgical treatment. It is not remarkable that high percentages of "cures" are still reported, while the average person with a hernia, on the other hand steadfastly persists in wearing a truss? If asked why he refuses operation, the usual reply is that he knows several persons who have had it done unsuccessfully."

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inner side of the internal abdominal ring lies the deep epigastric artery.

The inguinal canal contains the spermatic cord in the male and the round ligament in the female, together with the ilio-inguinal nerve and the genital branch of the genito crural nerve. As an oblique inguinal hernia passes down the canal it pushes before it certain layers of tissue which are called its coverings. From without inwards these are: skin, superficial and deep fascia, the intercolumnar or external spermatic fascia which represents the transverse fibres of the external oblique, the cremasteric fascia and muscle which is a direct continuation of the internal oblique, the infundibuliform or internal spermatic fascia which is a prolongation of the fascia transversalis, the extra peritoneal fatty and areolar tissue; and finally the peritoneum which forms the sac of the hernia. In an oblique inguinal hernia the neck of the sac is always to the outer

side of and close to the deep epigastric artery.

A direct inguinal hernia does not enter the inguinal canal by the internal ring. It leaves the abdomen to the inner side of the deep epigastric artery and passes out through the external ring. The contents of a hernial sac are either omentum or gut or both.

CAUSATION.

Two classes of causes are important in the descent of a hernia.

I. Those which have to do with abnormalities of the abdominal wall *e.g.*

(a) Scars of old operations or injuries which give way before increase of intra-abdominal pressure.

(b) Inherited weakness of the abdominal musculature and a marked patency of the rings.

(c) Presence of a pre-formed sac, namely a congenital or a developmental

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pouch or diverticulum of the peritoneum. Some authorities believe that it is only when such pre-formed sacs are present that the hernia protrudes.

(*d*) Non obliteration or partial obliteration of the funicular process in the male and the canal of nuck in the female.

II. Those causes that act by raising the intra-abdominal pressure *e. g.*

(*a*) Laborious occupations, heavy lifting etc.

(*b*) Chronic cough.

(*c*) Phimosi and narrowing of the anus in children.

(*d*) In the female pregnancy and parturition.

(*e*) Straining to pass water when an obstruction to the urinary outflow is present.

(*f*). Constipation and straining at stool.

RATIONALE OF INJECTION TREATMENT.

In addition to the presence of a sac preformed or acquired, it is essential if the hernia is to come down, for the external oblique to be seperable from the internal oblique and transversalis. If we can prevent this seperation the hernia can not descend. This is what the injection treatment accomplishes. By the injection of a suitable sclerosing fluid a mass of granulomatous tissue is formed in the inguinal canal. The dense scar that subsequently results unites the muscles firmly so that they can not be seperated.

SIGNS AND SYMPTOMS.

I. Swelling. In the initial stages the swelling is quite small and appears in the neighbourhood of the internal ring. At this time it may be noticeable only when the patient stands up or coughs. The pubic spine lies below and externally to the swelling. This

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point is important in its differentiation from a femoral hernia. The swelling may be dull on percussion or resonant according as the contents of the sac are omentum or gut.

II. Impulse on coughing. The swelling exhibits an expansile impulse so that it suddenly and sharply increases in size. The impulse is better marked when gut forms part of the hernial contents.

III. Reducibility—an uncomplicated hernia disappears when taxis is applied. It nearly always becomes smaller when the patient lies down. If gut is contained in the sac, the hernia reduces with a gurgle; if omentum is present, on the other hand gurgle is absent.

The symptoms due to a hernia are few and in many cases altogether absent. Pain at the site of the hernia is present in the early stages when the hernia is

quite small and is more common in muscular individuals. A certain amount of indigestion and abdominal discomfort may be present.

TECHNIQUE OF INJECTION.

A suitable, well fitting, spring truss with a perineal band, that retains the hernia under all conditions is selected. The elastic truss is useless. The truss is worn night and day until the hernia is cured.

The patient is placed on the operating table in a modified trendelenberg position. A pillow nearly six inches thick is placed under the sacrum. The head and the feet rest on the table. The skin is shaved and cleaned surgically. The hernia—omentum, intestine or both,—is reduced in the following manner. An assistant slightly abducts, internally rotates and flexes the thigh. The neck of the sac is steadied with the fingers of the left hand; the other hand applies

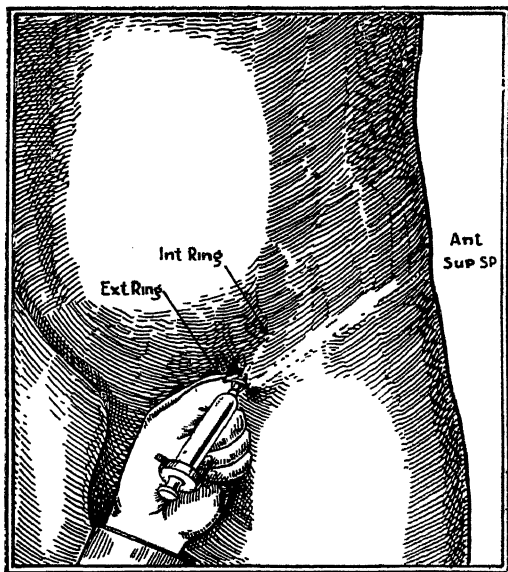
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steady pressure upon the contents of the sac. No force is applied and the manipulations should not extend very long. The direction of the pressure is upwards, outwards and backwards.

The operator makes sure that the canal is perfectly free.

The left middle finger is now invaginated through the external ring and the inguinal canal and the outline of the internal ring reached. The end of the left middle finger is slightly raised to lift up the external oblique, and the needle entered at an angle of 45° , at the lower margin of the internal ring. A needle inserted ~~p~~erpendicularly may involve injury or penetration of the spermatic cord with consequent pain and inflammation. The piston of the syringe is slightly drawn to see that the needle is not in a blood vessel and the injection slowly made.

If the hernia happens to be very small it may not be possible to lift the



—Technique for injecting inguinal hernia

external oblique up, with the left middle finger. In such cases the injection is made through the external ring to the canal either above or below the spermatic cord which is kept out of the way.

In children or very nervous subjects injections can be made in to the neighbourhood of the internal ring without having recourse to invagination, the internal ring lying $\frac{1}{2}$ an inch above Poupart's ligament and midway between the symphysis pubis and the anterior superior spine.

The injection having been made, the operator fits the truss on. Till that time the patient lies fully relaxed as if he were a log. He makes absolutely no effort to assist the operator. This is a most important point and is thoroughly impressed upon the patient's mind.

Injections are repeated at intervals of 4 to 7 days according to the reac-

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tion, and from 16—30 are necessary to close the ring. A second truss of hard rubber is provided for use while bathing. While changing from one type of truss to the other the patient lies down and keeps the abdominal muscles relaxed. Since the cure depends upon the formation of a connective tissue granuloma the truss is worn constantly until the cure is complete. The patient is advised to continue to use the truss for a month after the last injection is made.

FEMORAL HERNIA

ANATOMY.

In this case the gut leaves the abdomen through the femoral ring and passess down in to the thigh along the femoral canal. This canal is the narrow interval between the femoral vein and the inner wall of the femoral sheath. Normally it is only a potential rather than an actual canal, is funnel shaped, about half an inch long and ends

opposite the fossa ovalis. A point on the inguinal ligament midway between the pubic spine and the femoral point indicates the position of the femoral ring. The centre of the fossa ovalis is situated three-fourths of an inch below this point. Coughing, lifting of heavy weights and straining against an un-naturally patent ring forces down the omentum or gut and the sac in front, in to the femoral sheath. The adhesions of the sheath prevent its passage downwards when it has travelled about $\frac{1}{2}$ an inch. It therefore passes forwards through the sphenous opening pushing the cribriform fascia that covers the fossa, before it. When the hernia has passed through the sphenous opening it tends to go upwards over the inguinal ligament, in the direction of the anterior superior spine. The neck of an inguinal hernia lies above the inguinal ligament whereas that of a femoral hernia lies below it. This is a helpful distinguishing point.

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TECHNIQUE.

The hernia is reduced exactly in the same manner as the inguinal variety. The direction of pressure is however different. It is first downwards, then backwards, and then upwards and inwards. When taxis is complete all swelling should disappear. The technique for injection is the same as has been described for inguinal hernia, only the amount of fluid injected is smaller. The femoral vein lies posteriorly and externally to the hernial sac and care should be exercised not to injure it. The femoral vein is held to one side with the finger and the needle inserted to its inner side and just above the internal sphenous vein.

UMBILICAL HERNIA.

TECHNIQUE.

Only true umbilical herniae are treated by the injection method. Ventral herniae near the umbilicus need surgical

attention. The hernial contents are carefully reduced by pressure backwards and injections made at the margins of the hernial ring. Care is taken not to puncture the peritoneum.

SCLEROSING SOLUTIONS.

MAYER'S FORMULA.

Mayer whose method has been above advocated uses the following formula:—

Zinc Sulphate	..	1 dr.
Phenol crystals	...	6 dr.
Glycerin	... ..	4 fl. dr.
Aq Cinamomi	...	1 fl. oz.
Fluid. Ext. Pinus Canadensis		5 fl. dr.
Sterilised chemically pure redistilled water	...	2 fl. oz.

PREPARATION.

Dissolve the zinc sulphate in the cinnamon water. Liquify the phenol crystals by heating. Add the glycerin. Shake thoroughly until mixed and

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cooled; then add the distilled water and finally the fluid extract of *Pinus canadensis*. Shake thoroughly.

Allow the fluid to stand for about a week, agitating the mixture several times a day. Subsequently it should be filtered. Before injecting, boil the solution in a glass tube or place it in the sterilizer in a porcelain receptacle.

Mayer advocates hypodermic needles of 21, 22, and 23 gage and from $\frac{3}{4}$ to $1\frac{1}{4}$ " long. For umbilical hernia the shorter needle is better.

The initial dose is 2 minims of this solution. At the second sitting the dose injected is $\frac{1}{2}$ c. c., at subsequent sittings from $\frac{1}{2}$ —1 c. c. according to the degree of inflammation produced. In children 2 to 4 minims are injected at intervals of a week. For femoral or umbilical hernia the dose is 4 to 8 minims for adults; in children 1 to 2 minims are enough.

MESTRE'S FORMULA.

Mestre uses a mixture of the tinctures of krameria catechu, monesia, dogrose and bilberry. Krameria is probably the most important constituent. Six to fifteen treatments are needed. The dose of the fluid is from 1-5 c. c.

COMPLICATIONS.

1. The needle may enter the sac of the hernia. In this case when the piston is withdrawn a clear peritoneal fluid is aspirated in to the syringe. The needle needs withdrawl and re-insertion in a slightly different direction. If the fluid enters the general peritoneal cavity a plastic peritonitis may result. No such mishap has however been reported.

2. The spermatic cord may be injured or entered. This should not however happen if the cord is kept out of the way. If it is injured pain and inflammation follow. The treatment has

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to be suspended for some weeks. To relieve the patient's pain an ice bag is applied and a ten grain dose of aspirin administered.

3. A burning sensation in the scrotum or penis or on the inner side of the thigh may be complained of. This is however transient.

4. Occasionally a cramp in the distribution of the femoral nerve followed by some paresis, makes its appearance. It disappears in the course of a few days and should occasion no anxiety.

CHAPTER II.

HEMORRHOIDS.

INTRODUCTORY.

The injection treatment of hemorrhoids is now a days at least as popular as the operative treatment. The reasons for this popularity are not far to seek. The treatment is painless; it is ambulatory; and hospitalization is not required. The danger of the anesthetic, however slight, is obviated. The use of the surgeon's knife,—in some quarters a greatly dreaded implement—is eliminated.

For properly treating hemorrhoids an intimate knowledge of the anatomy of the pile-bearing area *viz* the lower inch of the rectum and the whole of the anal canal, is necessary. So also are, a perfect understanding of the clinical features and the diagnosis. A brief reference to these therefore, will not be out of place.

ANATOMY.

The anal canal is from one to one and a half inches in length and is for our purpose divisible into two portions. The upper portion is lined with mucous membrane, the lower portion with modified epithelium. At the junction of the two portions is a thin wavy line—the white line of Hilton—which defines the area of the internal hemorrhoids from that of the external. In the upper portion of the canal are five to six vertical folds, called the columns of Morgagni. Each fold is one third to half an inch in length and contains an artery and a vein. Separating the folds are shallow grooves at the bases of which there are small crescentic valves called the anal valves. Whichever method of injecting the hemorrhoids is selected, injection should always be made above the anal valves.

Internal hemorrhoids are varicosities of the superior hemorrhoidal veins which

commence in the anal veins, proceed along the columns of Morgagni and communicate freely with one another to form a submucous plexus in the lower part of the rectum. Two or three inches above the lower end of the rectum superior hemorrhoidal veins pierce the muscular coat of the rectum. This circumstance together with the absence of valves, an erect posture, and a tendency to constipation explain the frequency with which hemorrhoids occur. The superior hemorrhoidal veins drain in to the portal system.

CLINICAL FEATURES.

The principal symptoms of internal hemorrhoids are—

1. Bleeding.
2. Prolapse.
3. Discomfort or pain.
4. Pruritus and local irritation.

Bleeding is an early symptom and may be small in amount or considerable.

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Early in the course it is noticed after defecation only occasionally, later on it becomes more and more frequent till a teaspoon or more is lost after every action of the bowels. Apart from a profound anemia to which it may give rise, it has a distressing mental effect for the sufferer.

Prolapse is a later symptom. When it first makes its appearance it occurs only during defecation after which act the hemorrhoids spontaneously return. Later on the patient has to return them by gentle pressure after every action of the bowels. Still later, coughing, sneezing and even walking are sufficient to cause a prolapse, and the patient has to return the piles every now and then from time to time. If the prolapsed piles are not returned, local irritation may give rise to eczematization, mucous discharge and even strangulation.

Uncomplicated internal piles do not cause any pain. Even in severe cases

HEMORRHOIDS.

all that is present is a sense of weight or a dragging sensation in the sacral region. Pain only occurs when internal piles become prolapsed and inflamed or strangulated.

DIAGNOSIS.

Bleeding, proplapse, discomfort and local irritation are important symptoms but a diagnosis of hemorrhoids should never be made from the history alone. Inspection, digital examination and examination with a speculum are essential to confirm the diagnosis. A general systemic examination should in addition be made in every case in which hemorrhoids are found to exist. One must make sure that they are the only pathological condition present.

INDICATIONS.

The treatment is indicated for only one type of hemorrhoids *viz* the uncomplicated internal hemorrhoids. W. S. Perrin divides piles in to first

stage, second stage and third stage piles. The first stage pile is small, covered by healthy mucous membrane, consists of a collection of small arteries, veins and capillaries embeded in loose areolar tissue, and is situated entirely above the muco-cutaneous junction. Unless it is exceptionally voluminous prolapse and strangulation do not occur. The only symptom at this stage is bleeding which is bright red and blood may be lost in large quantities at defecation.

The second stage pile is increased in length and bulk from being constantly dragged upon, the vessels are more tortuous and thickened and the mucous membrane is thickened with much loss of its bright red colour from repeated friction. The symptoms consist of less profuse and less frequent bleeding, with prolapse and spontaneous reposition of the pile. It is described as a mixed pile in that it is covered above by mucous membrane and below by skin, the skin

covered portion tending to form an external projection which is always present.

The third stage pile is still bigger and bulkier and consists chiefly of fibrous tissue with still more thickening and purplish colouration of the mucous membrane. Bleeding is much less frequent and may be entirely absent, the chief symptom being an almost intractable prolapse which may follow after the slightest exertion such as coughing, bending etc.; and even after its manual replacement, a portion of redundant skin protrudes at the anal margin. The most suitable type for injection treatment is the first stage pile, though second stage pile may be injected and rarely when the physical state of patients makes them unable to withstand an operation, the third stage pile also. Terrel whose experience in this line of treatment is vast says that the treatment is specific in that large class of chronic internal hemor-

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rhoids, the chief symptoms of which are protrusion and bleeding. The writer has treated a few cases of third stage hemorrhoids where the chief symptom was prolapse, with extremely satisfactory results.

CONTRAINDICATIONS.

These are—

1. Hemorrhoids secondary to gross organic disease local or systemic *e.g.* cancer of the rectum, pregnancy, cardiac disease or cirrhosis of the liver.

2. Skin tabs.

3. Rectal polypi or fibromata.

4. Inflamed, strangulated and irreducible piles.

Badly ulcerated piles that bleed freely are not a contra-indication and seldom bleed again after the first treatment.

SOLUTIONS EMPLOYED.

1. Terrel recommends a 5 per cent

solution of quinine and urea hydrochloride. Upto January 1929, Dr. Terrel had treated over 5000 cases. The solution has one definite advantage over oily solutions of drugs. It is a local anesthetic and it is not only absolutely painless but relieves any rectal pain that may have been present before treatment. Terrel writes, "any so called ambulatory or non-operative treatment for hemorrhoids that causes pain, or is likely to put the patient to bed, is a failure. An anesthesia and operation is far preferable if such is to be the case."

Bensaude and Oury, Howard, and many other operators advocate Terrel's solutions. It is also the solution the writer employs. Two hypodermic tablets of quinine and urea hydrochloride, grs. 2 each (P, D. & Co), dissolved in 5 c.c. of distilled water give approximately a 5 per cent solution. The solution should always be freshly prepared and boiled before use.

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2. Levy, Spiesman and many other authorities recommend the use of phenol in oil. The best strength to employ is 5 per cent.

APPARATUS.

1. Pile Syringe. A 5 c.c. model, provided with a glass barrel, manufactured by Messrs. Allen and Hanburys is very suitable, but is rather expensive. Fairly good cheap models are put on the market by several German firms.

2. A Speculum with an obturator and lateral slit. Terrel prefers the Brinkerhoff anal speculum which is supplied in two sizes 4 inches and 6 inches. Others there are who are partial to the Hirschman model. No particular model is however indispensable.

3. A head light. Some specula are provided with electric bulbs and make the use of a head light unnecessary.

4. Cotton swab applicators.

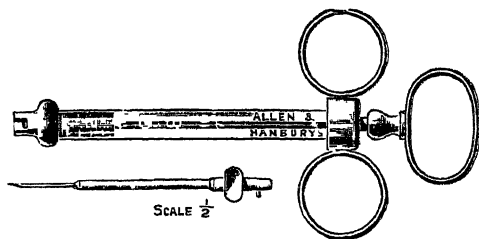


FIG. 2 —Syringe for injecting hemorrhoids.

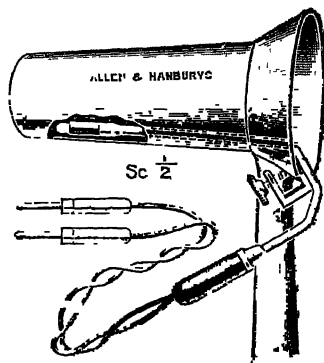
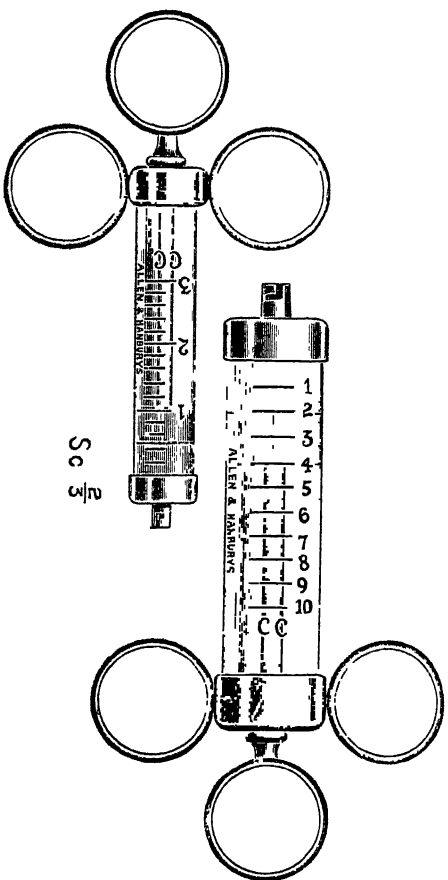


FIG. 3 —Self illuminating speculum for injection of hemorrhoids.



Full Size

Fig. 4.—Pile Syringes with needles.

PREPARATION.

Cleansing enemas stir up infective material in the colon and should never precede the injection treatment of hemorrhoids; cleansing cathartics are equally absurd. The anoscope is inserted and the region to be injected swabbed clean with absorbent cotton wool. A stick swab moistened with tincture of iodine is then pushed up and the site of the proposed puncture carefully swabbed just prior to the injection.

POSITION.

The injections are made with the patient in the right or the left lateral position. The lateral position is the most comfortable and the least embarrassing to the patient and at the same time affords perfect access to the region to be injected. The patient is asked to draw up his knees towards the chest and to raise the upper buttock with his hand.

TECHNIQUE.

A-PILE-CREST INTERSTITIAL METHOD.

(a) Solution Employed Quinine and Urea.

The patient is placed in the right or left lateral position. The anal speculum is well lubricated and inserted in to the rectum. The light is focussed on and the tumours brought in to view. The selected pile is cleansed with a cotton swab and tincture of iodine—preferably the French tincture—applied with a stick swab. A sterile 5 per cent solution of quinine and urea is drawn in to a syringe sterilized by boiling. The needle used is very fine and the injection made in to the interstitial tissue of the pile at its crest, underneath the mucous membrane. The needle is inserted at a point as far away from the skin margin as possible, the slide in the speculum being used as an aid in doing this. An injection placed in to the mucous membrane and not submucously, or too near the

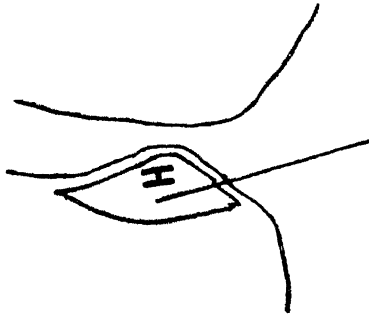
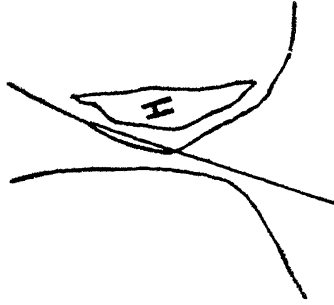


Fig. 5.—Wong technique



Right technique.

skin margin may cause pain or sloughing. Enough of the solution (1 c.c. or less) is placed in the submucous interstitial tissue of the tumour to slightly distend it. To prevent bleeding the needle is allowed to remain in the submucous tissue for a minute or so after the injection is completed. It is then withdrawn, tincture of iodine again painted at the site of the puncture and the speculum removed. The patient is sent back in to the waiting room and quietly kept there for approximately half an hour. There are no other restrictions placed upon him and he is allowed to proceed about his business as usual. One hemorrhoid is injected each succeeding day until all are treated, but, if the sphinctres are relaxed two or more may be injected at one time. After all the hemorrhoids have been injected once the patient is asked to return once weekly until a cure is obtained. This takes approximately six weeks for an average case. At these return visits

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treatments are administered alternately on the right and the left sides. All the piles on the right side are injected at one visit and those on the left side at the next. In this manner each hemorrhoid is injected once every two weeks.

(b) Solution Employed Phenol-in-oil.

The speculum is inserted and the hemorrhoid selected for injection swabbed with the tincture of iodine. The needle is passed just beneath the mucous membrane at the crest of the pile, the pile-mass not being penetrated at all. By making the injection high, the solution is carried down directly to the varicosities. Enough of the solution is slowly injected to slightly distend and somewhat blanch the pile. Usually 1 c.c. or less of a 5 per cent, solution are enough for one pile. A whitening at the site of the injection is an indication that the needle is not inserted beneath the mucous membrane; it should be pushed deeper.

Two hemorrhoids may be injected at a single sitting. It is proper to inject the bleeding piles first, as the patients want to be relieved of this unpleasant symptom as soon as possible; this also helps to establish the patients' confidence in the treatment.

B. QUADRANT METHOD

(a) Solution employed Quinine and Urea.

Dr. Aaron describes the method as follows:—

“I always use a 5 per cent sterile solution of quinine and urea hydrochloride and have never found it necessary to use a stronger solution. Stronger solutions may possibly cause sloughing, which never occurs with a 5 per cent solution, providing the injection is made sufficiently deep and not to interfere with the superficial circulation.

“The needle is introduced through the mucous membrane in to the tissue at

the centre of the quadrant, and the solution is so injected as to saturate this entire segment of the rectum. To accomplish this requires from 1 to 5 c.c., depending upon the size of the enlarged veins in the quadrant. After the needle is inserted well in to the body of the quadrant, it should be held in the same position for a moment after the injection, to prevent bleeding at the point of puncture. The following day a digital examination shows the quadrant, as a large, thickened, indurated mass. This induration gradually diminishes in size and at the end of a week is nearly all absorbed. Quinine and urea hydrochloride is a decided hemostatic, and a bleeding hemorrhoid will rarely continue to bleed after the first treatment, providing the quadrant injected contains the bleeding veins. The hemorrhoids become atrophied as a result of the constriction of their blood supply.

“The anal region is to be thoroughly

cleansed with soap and water, followed by the application of alcohol, without shaving. We divide the anal region into four equal parts by an imaginary line along the raphé ano-coccygeus and a transverse line through the ischia at right angles to this line. We thus have four quadrants.

“It is important that the injection be made a little above the internal sphinctre, because all the main blood vessels of the hemorrhoid usually enter from the upper part. By making the injection high, the solution is carried directly to the hemorrhoid.

“The exposed quadrant is now thoroughly swabbed with alcohol, and at the point of puncture a drop of tincture of iodine applied. The quinine and urea solution should be injected slowly, under light pressure, until the quadrant enlarges and distends to the size of a small English wal-nut.

The injection should be made submucously, in a line with the walls of the anal canal. The needle is held in position for a moment to prevent oozing at the point of puncture and is then withdrawn and the anoscope is removed".

The patient returns a week after the first injection and a second quadrant is injected. The injections are repeated at weekly intervals till all four quadrants are injected. More than four injections are seldom necessary. The method is successful even when there is prolapse, protrusion, hemorrhage or ulceration. The prolapse must of course be replaced, before treatment.

(b) Solution employed Phenol-in-Oil:—

A 5 per cent solution of carbolic acid in almond oil is prepared and 1-2 c.c. injected between the mucosa and the muscular coat of the rectum, well above the pad of piles. If the needle is in the right position a translucent tumour appears

with little blood vessels running over it; if the needle is too superficial a white spot appears and the injection is stopped; if too much force is required to force the oil in, the needle is probably too deep and should be withdrawn. Care should be taken not to inject the oil in to to a vein. The injections are given once every week, and a different quadrant selected each time. Four to six treatments are required to complete a cure. Often the patient complains of a burning sensation and weight or even pain after injection of carbolic acid. This may last an hour or more.

AFTER TREATMENT.

Bowel movements should be avoided for several hours following treatment. A table spoon of liquid paraffin administered morning and evening for some days, acts as a lubricant and prevents trauma and prolapse. If pain is present, an antiseptic and anesthetic ointment

should be prescribed for local use.

COMPLICATIONS.

1. *Pain*

It may be due to an injection made too low and close to the skin margin, or to infection or prolapse. If due to prolapse the piles are replaced after washing with cold water. In any case grs. 10 aspirin and the use of the following ointment

R.

Novocaine	gr. 10
Morphin Hydrochlor	gr. 2
Ung. Belladonna	...
Ung. Stramonium.	— ...
Ung. Acid. Tannici	<i>aa</i> ziis

applied locally thrice daily brings relief.

2. *Sloughing.*

It is caused by placing the injection too superficially or by injecting too much or too concentrated a solution. With

the solutions and the technique advocated above it should not occur.

3. *Infection* followed by abscess or fistula formation has been reported in a few cases. Treatment appropriate to these conditions should be at once instituted.

4. *Secondary hemorrhage* is due either to infection or necrosis; the only way of preventing the latter condition is in exercising caution in the amount of solution injected, and in depositing the solution in the right place.

5. *Recurrence*. It means that all the veins have not been treated. All that is necessary is another injection or two.

"DON'TS" IN INJECTION OF HEMORRHOIDS.

Weit kamp calls attention to following "don'ts" which may prove helpful in avoiding trouble:—

1. Don't inject hemorrhoids without being absolutely positive as to the patho-

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logy existing; a cancer or polyp may cause the symptoms which may be attributed to hemorrhoids.

2. Don't use solutions which are employed for sclerosing varicose veins, they will cause trouble. Conversely, solutions used for hemorrhoids are not to be used for varicose veins.

3. Don't use mineral oil as a diluent for phenol as it will cause tumour masses. Vegetable or animal oil should be used.

4. Don't inject the usual amount of any solution the first time as the patient may have an idiosyncrasy for that particular drug.

5. Don't inject external hemorrhoids as they are not amenable to this form of therapy. Neither should sentinel piles or skin tags be injected; for they must be surgically removed.

6. Don't inject external thrombosed hemorrhoids; for they must be opened and the clot evacuated. .

7. Don't inject hypertrophied papillæ mistaken for hemorrhoids.

8. Don't to sum up the preceeding three points, inject anything below the muco-cutaneous or ano-rectal line; as it will cause pain and bring no results.

9. Don't inject edematous prolapsing piles, as a greater prolapse will be produced. An injection high up with a reduction of the mass may bring results.

10. Don't inject too superficially as it may cause sloughing.

11. Don't inject too deeply as the hemorrhoidal plexus is in the submucosa and injection deeper than this is lost.

12. Don't reinject the same location too soon; it takes 3 to 4 weeks for the solution to do its work.

13 Don't reinject at any time before palpating the region. If it is hard or indurated, injection should not be given until this has entirely subsided; it may

not then need more.

14. Don't transfix the area of injection as the solution will be lost and the labour be of no avail.

15. Don't inject if the solution enters only under marked pressure as this is an indication that one is not in correct place.

16. Don't continue with an injection that is causing marked pain, for it is nature's warning of danger ahead.

17. Don't by any means, inject if the speculum shows that a slough has occurred, a condition that rarely if ever occurs with the proper technic.

18. Don't stop treatment until a complete cure has been produced else a recurrence will follow. On the other hand, do not continue injections after sclerosis is secured, for a new trouble may arise.

CHAPTER III.

HYDROCELE.

Hydroceles are divisible in to two main classes—

1. Primary hydroceles in which there is no abnormality in size or consistency of the testicle, the epididymus or the cord.

2. Secondary hydroceles in which the fluid is the result of some underlying pathological state of the testicle, the epididymus or the cord.

Only the primary type of hydrocele is amenable to treatment by the injection method. To distinguish a primary hydrocele from a secondary one it is essential to have recourse to a preliminary tapping after which the testicle and the epididymus can be examined by palpation.

Primary hydroceles are further sub-

divided in to

- (a) Communicating hydroceles.
- (b) Closed hydroceles.

Closed hydroceles only are injected.

A communicating hydrocele differs from a closed hydrocele in the variability of its size; it is bigger in the evening than in the morning. It is encountered among infants and children and usually heals spontaneously or after simple tapping. It should not be injected.

SOLUTIONS.

Among the solutions that have been employed for the obliteration of the sac the following may be mentioned.

- (a) Tincture Iodi Fortis.
- (b) Phenol.
- (c) Iodised Phenol.

Whitby who advocates its use recommends that 3 minims of a mixture of 4 parts iodine and 2 parts phenol should be injected for every ounce of the fluid

aspirated. More than 5 c.c. should never be injected at any one time; it is better to begin with 2 c.c.

(d) Sodium chloride.

(e) Sodium Morrhuate 5 per cent solution.

(f) Quinine hydrochloride and urethane.

The last two are the only solutions that should be employed.

Kilbourne and Murray consider that an ideal solution for the obliteration of a hydrocele must fulfil the following requirements.—

1. It must be painless.
2. It must not cause disability, so that the patient can continue his work.
3. It must be sufficient in obliterating all hydroceles without recurrences.
4. It must not be dangerously toxic.
5. It should be bactericidal in order to avoid infection.

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6. It must not subject the patient to the danger of hemorrhage in to the sac following the injection.

They are of opinion that quinine solution is nearly painless and quinine urethane is perfectly painless; clinically it is sufficient to obliterate hydroceles; and infection is far less common than in the case of sodium morrhuate.

For the first injection they employ 2 to 4 c.c. of the following solution:—

Quinine Hydrochloride	4 Gms.
Urethane	2 Gms.
Aq. Destil	30 c.c.

In subsequent treatments 3 to 10 c.c. of

Quinine Hydrochloride	4 Gms.
Aq. Destil	30 c.c.

is used, because it is more efficient in obliterating the hydrocele. Fluid always reaccumulates after the first injection. A second injection is made one week after the first. Subsequent injections,

if the fluid reaccumulates, are made at intervals of three weeks. The average number of injections required is from two to three.

If sodium morrhuate is employed as an obliterating fluid from 1 to 5 c.c. of a 5 per cent solution are injected, the amount varying with the patient's age and the size of the hydrocele.

APPARATUS.

The following apparatus will be required—

1. Twenty c.c. sterile syringe.
2. Ten c.c. sterile syringe.
3. One c.c. sterile syringe.
4. A sterile gauge 17 needle.
5. Collodium and cotton wool.
6. Suspensory bandage.
7. Absolute alcohol.

TECHNIQUE.

The position of the testicle is made

out by palpation of the hydrocele and by the trans-illumination test. Usually it is situated below and behind; sometimes it is below and in front. (Inversion of the testicle.) This condition should always be sought for, as in several instances the testes has been pierced by the needle when tapping collections.

The skin of the scrotum is surgically cleaned with absolute alcohol. After novocaine anesthesia a number 17 needle with its bevel filed off is introduced in to the sac, the fingers of the left hand protecting the testicle and at the same time stretching the skin over the hydrocele. The needle is steadied and kept in place by the fingers of the left hand and the 20 c.c. syringe attached.

The contents of the hydrocele are aspirated and a ten c.c. syringe charged with the sclerosing fluid attached to the needle. The injection is made in to the sac and the puncture sealed with

collodium. The sac is then gently massaged, a suspensory bandage applied and the patient left free to go about his business.

A trocar should not be used for aspirating hydroceles as it produces a hole so large that leakage of solution and consequent sloughing may occur.

CHAPTER IV.

VARICOSE VEINS.

INTRODUCTORY.

In the year 1851 Pravaz invented a syringe and used it to inject aneurisms with perchloride of iron. The Lyons school, taking up the idea used the same agent in the treatment of varicose veins. A number of other drugs were injected both intravenously and perivenously during the years that followed. Surgical cleanliness was in those days unknown. Sepsis supervened in a number of cases and the treatment fell in to disrepute.

It was revived by Lincer of Tübingen in 1915. Using a half to one per cent, solution of mercuric perchloride he reported a large number of successful cases. Mercury however proved extremely toxic and was soon given up.

Sicard, in 1917, while giving Luargol intravenously and Genevrier making

intravenous injections of quinine, noticed that these drugs often caused obliteration of the veins. Upon these observations they built the edifice of the modern treatment of varicose veins.

THE SOLUTIONS EMPLOYED.

The ideal drug for use in the intravenous injection treatment of varicose veins has yet to be discovered. The more important of those employed in recent times are:—

- I. Quinine and Urethane.
- II. Sodium Morrhuate.
- III. Sodium Salicylate.
- IV. Glucose.
- V. Glucose and sodium chloride.

We shall briefly discuss each of them.

I. Quinine and Urethane

The formula employed is—

Quinine Hydrochloride	4 Gms.
Urethane	2 Gms.
Distilled water	30 c. c.

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Wheeler considers it as the solution of choice. Maingot advises, that when quinine and urethane is selected, not more than $\frac{1}{4}$ c.c. should be injected at the first sitting. Subsequently, 1 to 2 c.c. may be injected at one or more points in the vein. The total dose at a single visit should not exceed 3 c.c.

Its advantages are :—

1. The clot is extremely tenacious and nonfriable.
2. The injections are painless, no cramps are produced.
3. The number of injections required is smaller.

Its disadvantages are :—

1. It is contra-indicated in pregnancy and during menstruation.
2. It gives rise to extensive sloughing if introduced outside the vein.
3. The small amount that can be safely injected limits its usefulness.

All observers are agreed that it is one of the most useful and successful of the sclerosing solutions used in the treatment of varicose veins and the allied conditions.

II. Sodium Morrhuate.

Five per cent solution in water is one of choice though a ten per cent solution is required for obstinate and advanced cases. The dose is $\frac{1}{2}$ to 1 c.c. at intervals of 3 to 4 inches. Five to ten c.c. is the maximum dose at one sitting, the average being from 2 to 4 c.c. Frederick L. Smith, considers sodium Morrhuate superior to quinine and urethane solution and also to equal parts of dextrose 50 per cent. and sodium chloride 30 per cent. Tunnick, Nack and Levy are also partial to solutions of sodium morrhuate.

ADVANTAGES.

1. It is much less irritant than Quinine urethane, salicylate or other solutions, and does not always produce sloughing if injected in to the subcuta-

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neous tissues. The 3 per cent. solution can be safely used in stellate or "spider burst" veins without the least fear of necrosis.

2. It causes no general systemic reaction.

3. The chemical venitis compares with that of quinine.

4. There are no cramps and the actual injection is painless.

III. Sodium Salicylate.

It is used in three strengths, 20 per cent., 30 per cent., and 40 per cent. To determine any local reactions and the susceptibility of a particular person 2 c.c. of a 20 per cent. solution are injected at the first sitting, 10 c.c. of the same solution are administered the next time. If there be no result 30 per cent. and then 40 per cent solutions are injected at subsequent treatments. The maximum dose injected should not exceed 10 to 15 c.c. at any one treatment. If the

result be still unsuccessful the salicylate should be discarded and some other substance used.

The injections are followed by painful cramps in the calves. Sloughing and ulceration result on introduction of even a few drops outside the veins. The solution is not recommended for use in the treatment of varices.

IV. Glucose.

Two to five c.c. of a 60 per cent. solution are injected at each sitting.

Its advantages are.—

1. It causes no systemic disturbance.
2. It does not give rise to sloughing in the tissues outside the vein.

It has however the following disadvantages.

1. It gives rise to a loose clot formation over large areas of the treated vein.

2. A majority of cases of pulmonary embolism resulting from injection treatment of veins has followed the use of glucose solutions.

As sugar solutions are not corrosive they require a longer contact with the endothelial lining of the vein. To accomplish this Pott recommends the use of a vein occluder. This is left in position for at least five minutes after the injection.

V. Glucose and Sodium Chloride.

De Takats believes that the best solution is a mixture of 50 per cent. dextrose and 30 per cent sodium chloride in equal parts. Five to ten c.c. of the solution are used at one injection. Solutions which turn brownish yellow should be discarded. Its disadvantages are embolism and recurrence in about 10 per cent. of the cases.

The consensus of opinion is in favour

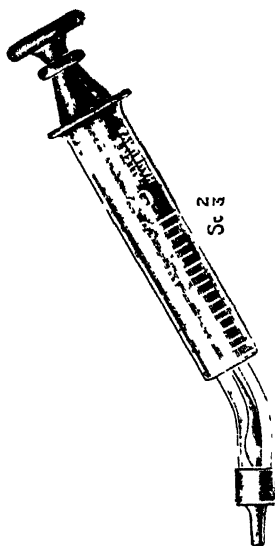


Fig. 6.—Varicose vein syringe.

of quinine and urethane, and sodium morrhuate solutions and these are the ones recommended for use.

APPARATUS.

1. A 2 c.c. record syringe or an all glass syringe of the same capacity.
2. A number 16 gauge needle, sharp but with a short bevel.
3. The sclerosing solution, sodium morrhuate or quinine and urethane.
4. Absolute alcohol, cotton wool and bandage.

Technique. The patient either sits in a chair with the foot of the leg to be injected, resting on a stool, or assumes the recumbent position. The latter position has the advantage that the veins are relatively empty and a more intimate contact between the sclerosing solution and the endothelium of the vein is permitted. The clot formation is thus minimized and a better sclerosis secured.

the vein for a minute after the injection. It is then rapidly withdrawn and pressure applied over the puncture with a cotton swab saturated in alcohol. This pressure is maintained for three or four minutes. After this there is no hemorrhage, sterile cotton wool is put on and the leg bandaged.

More than one injection may be made at one treatment. After the injection the patient rests for about 10 minutes. He can then go but should not do too much. The injections are repeated every week till all the veins are obliterated.

CAUSES OF FAILURE.

These are divided under the following heads:

I. Faults in the needle.

If it is not extremely sharp the vein instead of being punctured is torn; if its bevel is too long the vein may be trans-fixed; if its bore too large leakage occurs

on withdrawal of the needle.

II. Faults in the technique.

Enough care is not exercised to maintain an intimate contact between the solution and the veins. If the vein is not emptied of blood, too great a dilution occurs; and if is not compressed above and below, the solution is carried away before it acts on the endothelium of the part injected. Failure to apply pressure pads after the injection result in very large or soft thrombi.

III. Imperfect after treatment.

After the completion of the treatment the legs should be bandaged for a period of three weeks. Failure to observe this precaution often leads to recanalization and recurrence.

CONTRAINDICATIONS.

These are :—

1. Acute phlebitis.
2. Deep thrombosis.

3. Extensive cardiovascular or renal disease.
4. Extensive skin disease of the legs.
5. Advanced cirrhosis or diabetes.
6. Extreme old age.

If the varices are due to obstruction from a pelvic or abdominal tumour, it should first be removed and the veins treated after lapse of a reasonable time. Pregnancy is not a contra-indication if use is not made of quinine and urethane. No injections are made during menstruation.

COMPLICATIONS.

Pulmonary infarction is responsible for almost all the reported cases of death. Mepheaters and Rice have reviewed the mortality literature in connection with the injection treatment of varicose veins. They located seven deaths in a total of 53,000 cases treated by this method. Three deaths were traced to the use of

sugar solutions and another three to solutions of sodium chloride. The treatment is however perfectly safe if acute phlebitis is excluded and sugar or sodium chloride solutions avoided.

2. Sloughing often follows the use of sclerosing agents in the treatment of varicose veins. It is in a great majority of the cases due to leakage through the punctures, of the solution injected. In a small number the solution passes out of a very thin vein by the process of osmosis. If the injections are made according to the technique outlined in this chapter this complication should be rare.

3. Cramp occurs with injections of sodium salicylate solutions and is not encountered with solutions of quinine and urethane and sodium morrhuate.

4. Swelling and redness in the course of the vein is due to an ascending venitis. It occurs when quinine is used for the

obliteration of the veins. It however soon passes away.

5. *Constitutional* symptoms in the way of nausea, cold sweats, slowing of the pulse, noises in the ears and giddiness may occur after injection of sodium salicylate and quinine. When the latter solution is injected personal idiosyncrasy should always be tested for.

6. Recurrences are encountered in from 5 to 20 per cent. of the cases injected as against 30 per cent in cases where surgical excision is carried out. To prevent recurrences it is advisable to locate the great sphenous trunk and sclerose it up to the sapheno-femoral opening. The veins should be emptied before injecting and if necessary a vein occluder utilised to aid concentration. Tight elastic garters should not be used after the treatment is concluded.

CHAPTER V.

VARICOCELE.

ANATOMY.

Varicocele is a varicose condition of the veins of the spermatic cord or the pampiniform plexus. The veins in this plexus are divisible into three groups, an anterior group, a middle group, and a posterior group. It is in the anterior group that the condition commonly occurs.

CAUSATION.

The anatomical causes that render these veins liable to this affection are:—

1. They occupy a dependent position.
2. The main vein has a nearly vertical course and is very long.
3. The veins are very large as compared with the corresponding arteries, reducing the vis-a-tergo to a minimum.
4. They are situated in a loose tissue and are without support.

5. They have few valves which are also imperfectly formed.

6. They are extremely tortuous and enter into many anastomoses.

7. They are exposed to pressure in the inguinal canal

The left anterior plexus is more frequently affected than the right in the proportion of thirty to one, for the following reasons:—

1. The veins of the left cord are much larger than those of the right.

2. The left testicle hangs lower than the right.

3. The right spermatic vein joins the vena cava at an acute angle while the left spermatic vein joins the left renal at a right angle.

4. The left vein in passing beneath the sigmoid colon is exposed to pressure from the bowel contents.

Varico-cele is commonly encountered

in youngmen and is often discovered only accidentally during a medical examination for the public services. It however occurs also in older individuals and may be due to a malignant growth inside the abdomen—frequently a hypernephroma of the left kidney.

SYMPTOMS AND SIGNS.

It develops slowly during the years that follow puberty and may cause no symptom at all. Later on it may give rise to a dragging sensation along the cord and the inguinal canal. The discomfort is always worse after long standing or walking. Some time a definite ache or even a neuralgic pain in the testicle is complained of. Mental depression, sexual hypochondriasis and nocturnal emissions may occur and have a deleterious effect on the patient's general health.

On inspection the scrotum is unduly pendulous and the dartos is deficient in

tone. The walls of the scrotum are thin and transparent and on stretching the skin numerous dark blue veins become visible.

On palpation the classical sign of the "bag of worms," is obtained. The swelling almost disappears in the recumbent position and reappears again in the erect posture.

TREATMENT.

Three modes of treatment are known, the palliative treatment, the injection treatment and the operative treatment.

The palliative treatment consists in the regulation of the bowels, cold sponging of the scrotum night and morning, the use of general tonics and a properly fitting suspensory bandage to support the scrotum. Palliative treatment will, however, not eradicate the condition. It must, however, be realized that it is the only method of treatment to be employed

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in symptomless cases and one should never be eager to inject small varicoceles.

The operative treatment suffers from a number of disadvantages, the principal one being that the testicular function is destroyed in 76 per cent of the cases operated upon. According to Nitch, atrophy ensues in 21 per cent, and fibrosis in 55 per cent. We do not have any reliable figures regarding the fate of the testicle after injection treatment, but the results certainly compare favourably with those obtained after operative treatment. Its advantages are that it is ambulatory, it is nearly painless and that no general anesthetic is required.

SOLUTIONS.

Any of the two following solutions may be employed and are satisfactory.

1.

Quinine Hydrochlor	4 Gms.
Urethane	2 Gms.
Aq. Dest	30 c.c.

2. Sodium Morrhuate 5 per cent. solution.

APPARATUS.

1. A 2 c.c. record syringe.
2. Absolute alcohol.
3. The sclerosing solution.
4. A suspensory bandage.

TECHNIQUE.

The patient sits upright with his knees well apart, on the edge of a chair, so that the veins are distended with blood. The scrotum is thoroughly cleaned with absolute alcohol or a 5 per cent. solution of thymol in alcohol. The syringe is loaded with the sclerosing solution and the scrotum gently but firmly held by the thumb and the fingers of the left hand. The skin of the scrotum is slightly put on the stretch to make the vein loops conspicuous. The most prominent loop is selected. Without relaxing the hold the needle is passed in to the selected loop. It may

be that the needle does not enter the vein immediately; in that case it should be slightly withdrawn and with a little manipulation the vein may be pierced. A bead of blood appears in the barrel on slight traction of the piston if the needle is in place. The piston is then pressed home slowly and without jerk. If the patient complains of a sensation of burning, or a gradual swelling occurs, the needle is not in the vein. It is a signal for stopping the injection at once or irreparable harm may be done. The fluid injected, the needle is withdrawn and the point of the puncture pinched between the thumb and the fore-finger of the left hand. The patient keeps sitting for a minute or two after the injection to bring about an intimate contact of the sclerosing solution and the varicosities. He then lies down; the scrotum is raised and pressure applied for another two or three minutes on the point of puncture which is now seal-

ed with collodion. The patient keeps lying on the couch for ten minutes during which time a well-fitting suspensory bandage is put on. He can then leave the consulting room.

The dose of sodium morrhuate solution is 2 c. cm., that of quinine-urethane 1.5 c. cm. One injection is often, enough, to eradicate the condition. On the day after the injection the scrotum is tender and there may be some pain in the inguinal region. The varicosities feel like hard cords for a week or two after the injection and are still tender. Within a few weeks after the treatment a diminution in the size of the varicocele and the scrotum is obvious and the dragging or aching etc. disappear.

CHAPTER VI.

BURSÆ AND GANGLIA.

BURSÆ.

Brusitis commonly occurs in the vicinity of the patella and the olecranon process. Bursæ that communicate with joint cavities should never be injected.

APPARATUS.

1. A sterile 10 c.c. syringe.
2. A sterile 2 c.c. syringe.
3. Elastoplast bandage.
4. Tincture of iodine, swabs etc.

SOLUTION TO BE INJECTED.

A 5 per cent. solution of sodium morrhuate.

TECHNIQUE.

The skin over the bursa is sterilized by painting with tincture of iodine, a hypodermic needle with a moderate bore is introduced into the cavity of the bursa and its contents aspirated. The ten c.c. syringe is now detached and a 2 c.c.

syringe charged with a 5 per cent solution of sodium morrhuate is substituted. The solution is injected into the cavity of the bursa, the needle is withdrawn and the puncture sealed with collodion. The entire area is firmly bandaged with an elastoplast bandage. The elastoplast bandage is removed after a period of seven to ten days and a fresh bandage applied. If on removal of the bandage the bursa shows some swelling, its contents are reaspirated and the bandage applied without further injection of sodium morrhuate.

GANGLIA.

It should be ascertained first that the ganglion does not communicate with a joint cavity. The procedure for injecting a ganglion is exactly the same as described for bursæ; only the needle employed should be one of larger bore. Thin-walled ganglia are more successfully treated than those with thick walls and a small cavity.

CHAPTER VII.

INJECTION THERAPY OF CERTAIN NEUROLOGICAL AFFECTIONS.

LUMBAR PUNCTURE.

This procedure is indicated both for diagnosis and for therapy. It is very simple to perform and no physician should hesitate to carry it out when either the diagnosis is in doubt or the patients' life depends upon the intrathecal medication.

SITE OF PUNCTURE.

With a skin marking pencil the highest points on the two iliac crests are marked. A transverse line joining the two marks cuts the vertebral column at the level of the 4th lumbar spine. The space below *i.e.* between the fourth and the fifth spines is the ideal one for the puncture.

POSITION.

If the patients' condition allows the position of choice is the sitting one, with the thighs slightly parted, the hands resting on the thighs and the patient bent forward, permitting a maximum of space between the laminæ. If this position is not possible as in some cases of cerebero-spinal fever and other grave conditions the left lateral position may be used. An assistant placing one of his hands beneath the patients' knees and the other below his occiput brings about full flexion of the spine.

TECHNIQUE.

The skin is disinfected with tincture of iodine. A sterile lumbar puncture needle approximately 8 centimetres long and of as fine a calibre as possible is introduced in the middle line between the fourth and fifth spinous processes. It is directed slightly upwards. At a depth which varies with the age and the

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size of the patient a slight increase of resistance is encountered, due to the ligamenta flava. With a little increase of pressure the ligament gives way and the needle enters the spinal canal. In adults of normal size the canal is entered at a depth of 2" to 2½", in children 1" to 1½" are usual. On withdrawal of the stylette the fluid appears and can be collected in a sterile tube. If the fluid is blood tinged, the needle has probably punctured a vein and should be pushed a little further. The clear fluid is received into another sterile test tube. It should be remembered, however, that in cerebral hemorrhage the c.s. fluid is discoloured with blood. Ninety-nine per cent. of the dry taps are due to faulty technique or the occlusion of the needle by a clot or tissue debris.

CISTERN PUNCTURE.

This procedure was, first carried out by Ayer and is useful both for purposes of diagnosis and treatment. In spinal

administration.

6. Lipiodol or serum.

7. Tincture of iodine, cotton swabs etc.

TECHNIQUE.

The puncture is made either with the patient in the sitting position or lying on one side. The skin of the back of the head is shaved up to the occiput and the whole region made sterile by painting with tincture of iodine. The skin and the deeper tissues are anesthetized with a 2 per cent. solution of novocain. The cistern puncture needle with stilette is inserted in the middle line just above the spine of the axis and pushed forwards and upwards in line with the external auditory meatus and glabella. In an adult of average size the needle reaches the atlanto-occipital ligament at a depth of 4 to 5 cm. As the needle reaches the ligament there is a feeling of slightly increased resistance. With a little

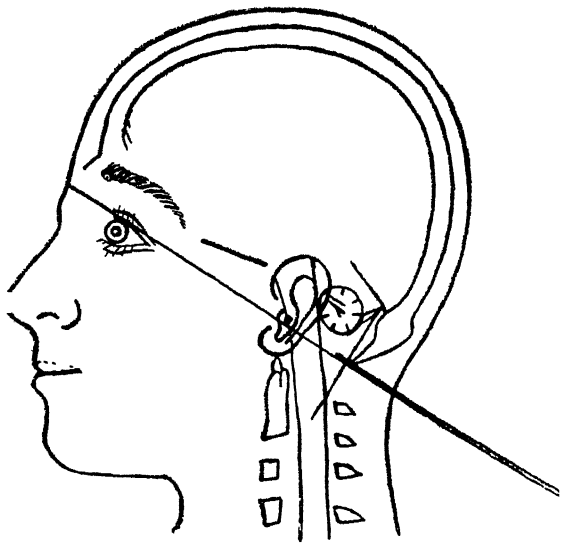


Fig. 8.—Cistern puncture needle in situ.

increase of pressure the ligament gives way. The medulla lies at a depth of 2.5 to 3 cm. from the atlanto-occipital ligament. There is, therefore, an ample margin of safety. Never should the needle be pushed beyond the 6 cm. mark. The stilette should now be withdrawn and if the point of the needle is in the subarachnoid space the fluid will drip out from the butt.

If the operation is, however, performed with the patient sitting and the pressure of the fluid in the theca is low, none may escape. Preliminary practice on the cadaver is necessary before attempting the operation.

FORCED DRAINAGE.

The procedure is described in detail by Kubie and Shults who introduced it. It consists of two steps: first, the reduction of intracranial pressure to atmos-

CONTRAINDICATIONS.

It is contra-indicated whenever an intracranial lesion is suspected, into which fluid will filter from the blood stream but from which it can not escape; in cardio-renal disease; and when active inflammatory disease is present elsewhere in the body. It is thus, contra-indicated in obstructive hydrocephalus, in the presence of cystic tumour of the brain and in fresh cereberal hemorrhage with engorgement and necrosis. In acute myelitis where swelling of the cord may cause block the procedure is not advisable. With an extremely thick gelatinous exudate such as is present in pneumococcal infections of the meninges, drainage may not be possible.

In active infections or inflammatory processes where the capillary permeability is increased the fluid pours out at the point of inflammation. It may be a distinct advantage in cystitis or pyelitis

but on the other hand in most infections *e.g.* severe bronchitis it can give rise to alarming symptoms.

The treatment is also contra-indicated in cardio-renal insufficiency.

TECHNIQUE.

A Bradford frame as long as the bedstead and about 36 to 40 inches wide is supported on the frame of the bed with blocks of wood, the blocks being of such a size that the head of the frame is about 8 inches higher than the foot. On this frame is stretched canvas in two pieces, with a gap of approximately 8 inches between the two. The pieces of canvas can be moved up or down to bring the gap opposite the region of the lower lumbar vertebrae. The patient rests on this frame and is rolled on to his back after lumbar puncture in such a manner that the needle is dependent through the canvas gap. The fluid drips into the graduated receptacle on the bed beneath.

The patient is covered up suitably to prevent his getting chilled.

In some patients it is possible to reduce the intracranial pressure to the same level as the atmospheric pressure without causing any inconvenience. In others escape of even a few c.c. of fluid gives rise to a severe headache. In the first class of patient the c.s. fluid is allowed to drain until the fluid escapes very slowly, before the intravenous injection is begun. In the latter class of patients the reduction of the intracranial pressure is effected by slow degrees with frequent interruptions of the drainage; sometimes periods of drainage have to be alternated with periods of intravenous injection.

The fluid is run in by the gravity method and during its administration, its concentration, volume, rate and duration are matters for consideration. The best concentration is one which is

just strong to prevent a hemolysis of the red cells in a fragility test performed before the operation. This is usually about 0.45 per cent solution of sodium chloride. From 2 to 3 litres of the solution may be injected in from 2 to 3 hours. The duration of the drainage varies from three hours to several days. The short duration drainages can be repeated at intervals of a week; the long duration drainage may sometimes be maintained for as long as two or three weeks in the face of more desperate and acute infectious processes.

An ordinary lumbar puncture needle is used if the procedure is intended to last only a few hours but in tuberculous or pyogenic meningitis where drainage is required for many hours arrangements should be made to keep the needle in place.

The only unpleasant symptoms are headache and nausea. Their treatment

consists in the application of ice bag to the head and the regulation of the drainage. In a procedure which may have to be maintained for long periods of time sedatives may be required. Amytal, 3 grains by mouth is one of the best. Both with and without sedatives patients fall asleep during the treatment.

THE SERUM TREATMENT OF C.S. FEVER.

The serum treatment of cerebrospinal fever introduced by Flexner, has considerably reduced the mortality from this disease. Lumbar puncture is performed in the usual manner and the c.s. fluid allowed to drain into a graduated sterile tube. It is advisable to let the fluid flow until as much as possible has run out. The stylet of the needle is replaced and preparation made for the introduction of the serum. The apparatus required is a

rubber tube eighteen inches long. At its upper end a glass funnel is attached, at its lower end is a metal nozzle which fits into the butt of the lumbar puncture needle. A small piece of glass tubing three inches from the lower end of the tube acts as a window. Between the metal nozzle and the glass tube is a clip.

The entire apparatus is sterilized by boiling and sterile normal saline run into displace any air. The saline is permitted to run out till its level reaches the bottom of the funnel, the serum warmed to the body temperature is poured into the funnel and its appearance noted at the glass window. The stylet is now removed from the lumbar puncture needle and the metal nozzle attached. The rate of flow is regulated by raising or lowering the funnel.

If a serum syringe is used to inject the serum, due care should be exercised to warm the serum and to inject

extremely slowly. Rapid injection of the serum is harmful and may even prove fatal.

In those cases where internal hydrocephalus develops it is advisable to tap the lateral ventricles, aspirate the fluid and introduce the serum.

In infants the region of the anterior fontanelle is shaved and the skin sterilized with tincture of iodine. A stout needle is inserted at the lateral angle and pushed gently towards the middle line for an inch to an inch and a half. The c.s. fluid in the ventricles is under great pressure so that it becomes quickly known when the needle enters it. The serum syringe is attached and as much of the fluid as will easily come aspirated. The serum warmed to the body temperature is carefully introduced, the bulk introduced being slightly less than the fluid withdrawn. In older children and adults the operation is a more serious

procedure and its performance should be left to the expert.

The dose of the serum is from 5 to 15 c.c. in children of from 1 to 5 years of age; in adults the average dose is 30 to 45 c.c. In severe cases the treatment may have to be repeated twice or even three times in the twenty-four hours. In a case of average severity the interval between the doses is 24 hours. The injections are continued until the clinical signs disappear and the fluid comes clear and is free from cocci. Four to five injections are usually required. Lumbar puncture may be continued once daily for several days even when the serum has been stopped.

INTRATHECAL THERAPY OF TETANUS.

Evidence as to the value of intrathecal administration of serum in the

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treatment of tetanus is so far conflicting. Nevertheless at least 16000 units should be given by this route during the first 24 hours. Bruce recommends the following scheme for treatment of acute cases:—

Day	Subcutaneous	Intramuscular	Intrathecal
First	..	8,000 units	16,000 units
Second	...	8,000 units	16,000 units
Third	...	4,000 units	8,000 units
Fourth	...	4,000 units	8,000 units
Fifth	2,000 units	...	...
Seventh	2,000 units	...	...
Ninth	2,000 units	...	...

Meltzer and Auer demonstrated that magnesium sulphate introduced into the circulation or brought into direct contact

with the nervous system possessed an anesthetic effect. There is ample evidence that this substance properly used may save life by abolishing the spasms, the tissues of the patient meanwhile getting time to destroy the tetanus toxin. The medicament can be administered by the subcutaneous, intramuscular, intravenous or intrathecal routes.

When the subcutaneous route is employed a 25 per cent solution of the drug is used, the dose being 1.2 to 2 c.c. for each kilogramme or 2.2 lbs. of the body weight. Meltzer recommends this route and advises that the injections be repeated every 6 hours. When the drug is administered intramuscularly, simultaneous ether anesthesia has a beneficial adjuvant effect. The dose is 2 c.c. of a 25 per cent solution for each kilogramme body weight. For intravenous injection a sterile 3 per cent solution of thrice recrystallized magnesium sulphate in distilled water is slowly run in at the rate

of 5 c.c. per minute. Administered in this manner there is considerable risk of producing respiratory embarrassment and cardiac failure. The route should be reserved for emergencies such as laryngeal or diaphragmatic spasm and the injection should be stopped as soon as muscular relaxation commences or signs of respiratory or cardiac embarrassment occur. Relief is obtained by intrathecal injection in half to one hour and lasts for from 12 to 30 hours. The dose is 1 c.c. of a 25 per cent solution for every 10 kilogrammes body weight; for a second dose 0.8 c.c. per 10 kilogrammes body weight is enough. In children 0.5 c.c. per 10 kilogrammes should not be exceeded.

As routine measure the timely and adequate use of the antitoxin together with subcutaneous injections of magnesium sulphate solution are recommended. Intrathecal route may be utilised if the spasms are severe.

A solution of calcium chloride neutralizes the effect of magnesium sulphate on the nervous system and should always be available. A sterile solution of 0.02 per cent calcium chloride in isotonic saline should be slowly run into the vein in case of respiratory embarrassment and the injection stopped as soon as spontaneous respiration is restored. In less urgent cases 30 c.c of a 2 per cent solution given intramuscularly proves sufficient.

ACUTE ANTERIOR POLIOMYELITIS.

The intrathecal administration of convalescent serum has reduced the incidence of paralyses from 46 to 5.7 per cent. To be of value however the serum must be given early and in the preparalytic stage. Unfortunately, however, accurate diagnosis in this stage except during epidemics is not possible and the serum

CHAPTER VIII.

INTRAPERITOEAL INJECTIONS.

Blackfan and Maxcy in 1918, first introduced the intraperitoneal injections of normal saline in the treatment of dehydration in infants. More recently intraperitoneal route has been utilised for the administration of dextrose, diphtheria antitoxin, neoarsphenamine, iron and citrated blood in infants and children.

ADVANTAGES.

1. It permits more rapid introduction into the body of relatively larger amounts of fluid than is possible by the subcutaneous route.
2. It is less painful than the subcutaneous or the intravenous route.
3. It does not produce shock—a result quite common after hypodermoclysis.

4. It is easier than intravenous transfusion and should prove convenient in smaller hospitals and genral practice.

DANGERS.

Ravenel in a hospital and private practice of nine years reports one case of perforation of the intestine and two cases of serious hemorrhage resulting from the puncture of "obliterated" hypogastric artery during the course of intraperitoneal injections in very young infants. In two of his cases, incompatible blood administered intraperitoneally produced severe local and general reactions.

CONTRAINDICATIONS.

1. Abdominal distension is an absolute contra-indication to intraperitoneal injections.

2. All abdominal lesions excepting purely bowel conditions, *e.g.* vomiting and diarrhoea.

APPARATUS.

1. A sterilized tube and funnel.
2. A sterilized, one and a half inch long needle, with a blunt short bevel.

TECHNIQUE.

The needle is attached to the rubber tube and the whole apparatus filled with saline to exclude air bubbles. The infant or the child is laid on the back and its legs held by an attendant. The abdominal skin is surgically sterilized. A site midway between the pubis and the umbilicus in the linea alba is selected, the tissues of the abdominal wall in this area are pinched up with the thumb and fingers of the left hand, and the dull, short, bevelled, needle introduced in an upward direction. Enough fluid to slightly distend the abdomen should be run in. Three hundred to four hundred c.c. at body temperature usually suffices for a small infant.

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1. Because it is below any omentum.
2. It avoids the bladder.
3. It obviates any injury to the liver which may be enlarged on the right side. Four injections at three day intervals were followed by four injections at seven day intervals. The same dose was used each time.

When it is proposed to transfuse citratad blood by this route, blood matching should always be done. Introduction of incompitable blood is dangerous and unwarranted.

CHAPTER IX.

INTRAVENOUS INJECTIONS.

TECHNIQUE.

When the amount of fluid to be injected does not exceed 10 to 20 c.c., the syringe method is used; when larger quantities have to be put in, the gravity method is applicable.

(a) The Syringe Method.

The patients' arm is placed in a position of supination and extension, and the veins at the bend of the elbow made prominent by tying a bandage, a handkerchief or a tourniquet above the elbow. A very suitable tourniquet consists of a piece of stetho-scope tubing the ends of which are held together by an artery forceps. If the veins are still not prominent the patient is instructed to keep the arm in a dependent position and to open and close his fist several times. In some cases where the arms are well

padded with fat one must locate the desired vein by touch or select a vein at the back of the hands. The forearm rests on a firm support and the skin at the site of the injection is swabbed with iodine. For success in intravenous therapy the needle should have a sharp point and not too long a bevel. A ten c.c. record syringe is the most suitable one to employ. The vein is steadied by the fingers of the left hand and the needle approximately an inch and a half long, with its bevel upwards, is placed over and in line with the long axis of the vein. The writer prefers to enter the vein directly though some authorities advocate a lateral approach. Cessation of resistance and the appearance of blood in the barrel on exercising a little suction are indications that the needle is in the vein. The constriction round the upper arm is now removed and the fluid to be injected slowly run in. At the end of the injection a few drops of blood should be

aspirated back into the syringe. This prevents deposition of irritating solutions along the track of the needle. After the needle is withdrawn, pressure is exerted for a short time on the point of injection with a sterile piece of cotton wool.

(b) Gravity Method.

An apparatus which makes the gravity method of intravenous injection a simple procedure has been put on the market by Messrs. Allen and Hanburys. It consists of an irrigator, a rubber tubing and an all-glass syringe with a lateral tube.

The entire apparatus is sterilized by boiling and a small quantity of sterile normal saline is placed in the irrigator. The piston of the syringe is withdrawn, the air bubbles eliminated and the saline allowed to run out to the zero mark on the irrigator. The piston is now pushed home and the remaining saline prevented from running out. The solution to be

injected is now placed in the irrigator which is suspended above the patient. The skin of the patient over the median basilic vein is sterilized with tincture of iodine and the needle introduced into the vein as in the syringe method. When the needle is in the vein, the pressure of blood will by itself force the piston out. A communication becomes established between the irrigator and the vein via the lateral tube in the side of the syringe and the solution automatically runs into the vein. The method is very convenient for saline infusions or when large volumes of medicaments have to be introduced.

PRINCIPAL AGENTS ADMINISTERED INTRAVENOUSLY.

These may be classified under four heads as follows:—

I. BLOOD TRANSFUSION.

II. SERA AND VACCINES.

III. DRUGS.

IV. SALINE AND DEXTROSE.

I. BLOOD TRANSFUSION.

INDICATIONS.

1. Sudden loss of a considerable volume of blood.

2. Anemias of slow onset, whether hemolytic or aplastic if the hemoglobin be below 50 per cent.

3. Hemorrhagic disease of the newborn.

4. Carbon monoxide or coal gas poisoning.

5. Acute septic infections.

DONOR.

Syphilis should be ruled out in the donor both by a physical examination and by a Wassermann test; he should not be suffering from any febrile disorder. The donor should belong to the same

blood group as the recipient as disclosed by the direct matching as well as the grouping test. A universal donor may be used if a donor of the same group as the recipient is not available in cases of emergency. It is better to use a different donor each time as hypersensitiveness to the blood of the same individual may develop; particularly is this important if there is an interval of several weeks between the transfusions.

TECHNIQUE.

(a) The direct method.

Two operators are required. One takes the donor's blood; the other injects it into the patient.

APPARATUS.

1. Four 20 c.c. all glass syringes with two 18 gauge and two 20 gauge needles.
2. Two sets of rubber gloves.
3. Two sterile towels.

4. Two tourniquets.

5. Absolute alcohol, sterile paraffin etc.

The operators put on the gloves and draw sterile paraffin through the needles into the barrel of the syringes; the excess is expelled. The syringes and the needles are put on a sterile towel. The tourniquets are applied and the anticubital fossæ of the donor and the recipient cleared with alcohol. A large needle is introduced in a prominent vein at the bend of the elbow in both the parties. One operator fills from the donor and hands the syringe to the other operator who injects into the patient at the rate of 20 c.c. in half to one minute. Syringes should be attached and detached to the needles very gently and the thumb should be placed over the needle outlet to prevent loss of blood while changing syringes.

(b) The citrate method.

APPARATUS.

1. A glass vessel of 500 c.c. capacity.
2. Two and a half per cent. solution of sodium citrate.
3. A large needle 15 to 18 gauge.
4. A glass funnel connected by 18 inches of rubber tube to a 20 to 21 gauge needle.
5. Sterile gauze, absolute alcohol etc.

The apparatus is sterilized by boiling for several minutes.

The tourniquet is applied and the donor's skin at the bend of the elbow cleaned.

The 15 to 18 gauge needle is inserted into a prominent vein and the blood allowed to flow into the glass holding 50 c.c. of a 2.5 per cent solution of sodium citrate. The blood is well mixed by stirring as it falls into the citrate solution.

It is then strained through 2 to 4 layers of sterile gauze to remove any clots and injected into the patient by means of the glass funnel and tube. The amount transfused should be approximately 500 c.c. of blood in an adult; in children 50 to 150 c.c. are enough. The first few c.c. of the blood should be injected very slowly and should cough, laboured breathing, disturbances of pulse-rate or abdominal or lumbar pain develop the transfusion should be discontinued. Half a c.c. of adrenalin chloride solution 1 in 1000, should at the same time be injected subcutaneously.

II SERA AND VACCINES.

SERA.

The following are the more important sera administered intravenously:—

1. *Anti-anthrax Serum.*

The usual mode of administration is

subcutaneous; in severe cases the initial dose should be injected into the vein. Sclavo's serum manufactured by Allen and Hanburys, Mulford or Behring may be used. The dose is 50 c.c.

2. *Anti-diphtheretic Serum.*

It is usually administered intramuscularly. In severe cases and those seen late intravenous route is preferable. Its dose is 5 to 10 thousand units to be repeated in 12 hours.

3. *Anti-dysenteric Serum.*

It is a polyvalent serum containing antitoxins against the Shiga Kruse type and bactericidal antibodies against the Shiga Kruse, Flexner and Y groups of dysentery bacilli. The dose is 20 to 50 c.c. intramuscularly or intravenously.

4. *Anti-meningococcal Serum.*

It must be given by the lumbar route; in septicemic conditions only is intravenous route also indicated.

5. *Antipneumococcal Serum.*

Felton's serum is a purified concentrated solution of pneumococcus antibodies prepared in a poly-valent form and containing immune bodies against pneumococcus Types I and II. Its potency is 5 to 15 times as great as that of ordinary anti-pneumococcus serum. Best results are obtained in Type I pneumonias; Type III cases do not show any beneficial results. In Type II and group IV infections those treated with serum do better than those treated without it. Lord Dawson is of opinion that Felton's serum should be administered in every case irrespective of the Type. Fifty to seventy-five c.c. should be injected intravenously during the first 24 hours. The cost of the serum is unfortunately very prohibitive.

6. *Anti-streptococcal Serum.*

It is marketed as anti-streptococcal serum puerperal, anti-streptococcal serum

erysipelatous, and anti-streptococcal serum polyvalent. It should be administered intravenously in doses of 50 to 100 c.c.

In every case where serum is intended to be administered intravenously the patient should be tested for hyper-sensitivity and if necessary desensitized in the routine manner.

VACCINES.

1. *Intravenous Streptococcic Vaccine Therapy in Chronic Arthritis.*

Clawson is of opinion that there is clinical improvement in 75 per cent of the cases following the intravenous administration of a streptococcus vaccine. Intravenous injections are given at intervals of from 5 to 7 days for the first 5 treatments and at 7 to 14 day intervals for subsequent treatments. The first dose is 100 million killed organisms and the dose is increased by 100 million killed

organisms each time. A reaction occurs in from 1 to 8 hours after the injections. As a rule not more than 8 to 10 injections are given.

2. *T. A. B. Vaccine.*

Its employment intravenously is treated in a subsequent chapter.

III. DRUGS.

1. ARSENICALS.

The standard method of treating syphilis is to administer a number of courses of intravenous injections of neosalvarsan and to supplement these with intramuscular injections of mercury or bismuth. The amount of neosalvarsan given depends upon the age and the sex of the patient. The general plan is, however, indicated by the following outline as recommended by Lees for the

treatment of a case of sero-negative syphilis:—

FIRST QUARTER.

(a) Eight intravenous injections of neosalvarsan at weekly intervals, commencing with 0.45 Gm. in males and 0.3 Gm. in females, rising to 0.6 Gm. in men and 0.45 Gm. in women, in this country.

(b) Weekly injections of mercury or bismuth are also given intramuscularly into the buttocks.

(c) A month's rest.

SECOND QUARTER.

(a) Five injections of 0.45 Gm. neosalvarsan at weekly intervals.

(b) Mercury or bismuth injections intramuscularly.

THIRD QUARTER.

Mercury or bismuth injections intravenously.

FOURTH QUARTER.

(a) Five injections of 0.45 Gm. of neosalvarsan at weekly intervals.

(b) Mercury or bismuth injections.

The bismuth or mercury injections are continued throughout the year. Potassium iodide gr. 5, three times a day is given for 15 days every three months during the rest periods throughout the two years.

During the two years course the following are the total quantities of the drugs administered:—

Neosalvarsan	...	11 Gm.
Bismuth	...	28 Gm.
Mercury	...	4 Gm.
Pot. Iod	....	200 to 300 Gm.

In a sero-positive case five courses of neosalvarsan, making a total of 14 Gm. of the drug, are given. If these do not produce and maintain a negative W. R. reaction, treatment can be continued into

the third or even the fourth years.

In neuro-syphilis Lees recommends a two-month course of weekly injections of tryparsamide 3 Gm., making a total of 24 Gm. of the drug. This course is repeated 2 or 3 times.

Neosalvarsan undergoes oxidation fairly readily and forms highly toxic products. The drug is put up in sealed ampoules filled with nitrogen. If a leak occurs in the ampoule, oxygen enters and the drug slowly oxidises. Every ampoule should therefore be tested before use by dipping in warm spirit. A leak is indicated by bubbles arising. The drug should be canary yellow and should not stick to the sides of the ampoule. It should be dissolved in cold, sterile, doubly distilled water.

The principal toxic effects may be divided into:—

(a) Early vaso-motor reactions which

appear either during or within a few hours of the injection. The chief symptoms are chill and rigors, followed by pyrexia and headache, together with a fall in blood pressure. Often there is œdema and urticaria. These early reactions may be alarming but are rarely fatal.

(b) Later reactions which occur after a few days, are much much more serious than the first type and occur most frequently after the second or third injections. They are divisible into three chief groups:—

- (i) The dermatitis group characterised by skin eruptions passing into exfoliative dermatitis and fever. In this group also occur broncho-pneumonia and albuminuria.
- (ii) The nervous group:—The symptoms appear within two days and are characterised by convulsions

and drowsiness which may pass on into coma or death. Encephalitis due to neosalvarsan poisoning is a most serious complication. It is now unfortunately rare.

(iii) Jaundice.

The incidence of toxic effects is reduced—

(a) If a reliable preparation of the drug is used.

(b) If a constant technique is maintained in the preparation and administration of the drug.

(c) If visceral disease is excluded or the drug cautiously administered when it is present.

(d) And, if the patients are carefully observed and examined while they are receiving a course.

Some protection is afforded to the liver if sugar is given before making an

injection. Two ounces of glucose in a tumbler of water, given half an hour before the injection, is quite good.

Neosalvarsan is of great use also in cases of quinine-fast malaria. A single injection of 0.3 Gm. to 0.45 Gm. often brings the temperature to normal. Quinine must of course be pushed subsequently.

Neosalvarsan is also of immense use in relapsing fever, in framboesia and in rat-bite fever. Local applications are beneficial in Vincent's angina.

2. *Mercurials.*

In the treatment of syphilis the usual mode of administration of mercury compounds is by the intramuscular route. Insoluble preparations are employed in preference to the soluble ones. The course consists of four or five injections at weekly intervals. Mercurial cream (B. W. & Co.) or grey oil (B. W. & Co.)

are quite good preparations to use. The dose of each preparation is 1 c c.

Mercurio-chrome 220 soluble.

In 1919 Young, Severty and White introduced the drug in the treatment of sepsis. The high hopes which were held out for it have not been unfortunately realized. It is however a powerful weapon worthy of trial in septicemia and chronic infections. It acts by both the molecules of its composition,—mercury and the dye fluorescein both having anti-septic properties. Recent literature is full of trials of mercuriochrome in various conditions. Its principal successes are reported in pyemia, puerperal septicemia, septic conditions of the genito-urinary tract, gonococcal infections and pneumonia. It has also been used in typhoid, plague and other conditions.

Young is of opinion that 3 to 5 mg. of the drug per kilogramme (2.2 lbs.) body weight is essential to success. (60 mg.

make one grain). These high doses are not given today. Experience has brought the dose down to 5 to 10 c.c. of a one per cent solution daily injected intravenously. Young contends that the smaller doses employed account for the indifferent results obtained. Reactions are more severe after larger doses and are classified as immediate and late. Immediate reaction partakes of the nature of protein shock. There is chill, high fever, nausea and vomiting but these pass off soon leaving the patient in a better condition than before. The late reaction is definitely of the nature of mercurialism,—stomatitis, persistent diarrhoea and partial suppression of the urine.

Salyrgan.

It is a ten per cent solution of mercury sodium salicylamido acetate put up in ampoules by Bayer Meister Lucius. It is an antisyphilitic and a highly

efficient diuretic in cardiac dropsy, ascites due to liver disease and pleural effusion. Acute nephritis is a contra-indication to its use. The solution is miscible with solutions of the salvarsan group and hence both the mercurial and arsenic treatment can be given at the same time in one injection. It is less toxic than novasural (Bayer) and as effective a diuretic as the latter. It acts better if ammonium chloride by mouth is also given for a couple of days previous to the injection. The dose is $\frac{1}{2}$ to 2 c.c. injected intravenously or intramuscularly three times a week.

3. *Gold Compounds.*

Gold has been used as a remedy for many centuries. Paracelsus advocated its use in the treatment of heart disease and tuberculosis. Practitioners of the Indian and Arabic systems of medicine have long been and are still prescribing it in the form of Makar Dhawaj and gold

leaf. Koch found that gold salts had a remarkably powerful bactericidal action on the tubercle bacillus. Mollgaard introduced Sodium auri-thiosulphate (Sanocrysin) in the year 1924, in the treatment of tuberculosis. Krysolgan, Solganol, Triphal, aurophos, aurosan and lopion are among some of the other preparations that have since been introduced.

SANOCRYSIN.

The drug is indicated in the following types of cases:—

1. Tuberculosis with fresh exudative foci.
2. In cases of artificial pneumothorax in which there is some active disease in the uncollapsed lung.
3. In patients with slowly progressive disease who do not improve with the routine treatment.
4. In patients who show clinical

arrest but still continue to bring up tubercle bacilli in the sputum.

5. In checking exacerbations of disease in the course of a chronic case.

The older and fibroid type of pulmonary lesions are not very amenable to this form of therapy. Abdominal tuberculosis is a contra-indication.

DOSAGE.

A suitable system of dosage for most patients is that recommended by Burrel. The treatment is begun with 0.1 gram. and the dose gradually increased to 0.2, 0.35, 0.5, 0.65, 0.8, 1 gram.—with an interval of three days between the first and second doses and a week between the following doses. In case of a reaction time is allowed till all effects of the reaction have passed off and then the same dose is repeated. The final dose should be repeated two or three times. The total dose should not exceed 5 to

6 grms. The course can be repeated after an interval of two months. Each dose is given intravenously dissolved in 10 c c. of distilled water. Solutions should not be boiled.

REACTIONS AND THEIR MANAGEMENT.

1. Rapid Rise of temperature, collapse and shock used to occur with the large doses that were advocated at the outset. Such large doses are seldom advised at the present time and with a judiciously arranged system of dosage such reactions should rarely if ever be encountered.

2. Transient albuminuria frequently follows the injections and although of no serious consequence should be regarded as a warning signal. No further treatment should be given until the urine is clear nor should the dose be increased at the next injection.

3. Papular eruptions, skin rashes, even exfoliative dermatitis, may be

encountered. It is an indication for going cautiously; sodium thiosulphate solution administered intravenously is of value in counteracting these symptoms.

4. *Digestive disturbances.*

Stomatitis, nausea and vomiting etc. are sometimes produced but are not serious.

MISCELLANEOUS. DRUGS.

1. *Caffiene Sodii Benzoas.*

It is indicated in acute cardiac failure. The intravenous dose is 2 to 4 grains; it may also be injected intramuscularly in $7\frac{1}{2}$ grs. doses.

2. *Calcii Chlor.*

The drug has a specific value in relieving tuberculous diarrhoea when every other measure has failed. It also relieves the pain in abdominal tuberculosis. The dose is 5 c.c. of a 5 per cent solution in distilled water to be repeated on alternate days or thrice a week as

necessary.

3. *Congo Red.*

It is a good remedy not often employed. It arrests the hemorrhage due to hemoptysis more effectively than any other agent; it also arrests other internal hemorrhages. The dose is 5 c.c. of a one per cent solution to be injected into the vein. The hemorrhage is usually arrested within a few hours. If necessary the dose may be repeated after 24 hours.

4. *Magnesii Sulphatis.*

A saturated solution of epsom salts and a saturated solution of granular sugar, equal parts, is practically a specific in a number of diseases. One half c.c. of this mixture, given intravenously and repeated every six hours, is an almost if not quite specific for septicemia. About four to five injections are necessary in severe cases. The treatment is of great benefit in gonorrhœa

and gonorrhœal arthritis. Half to one c.c. of the solution is injected intravenously each day; no local treatment is given but medicine by mouth may be ordered.

There is nearly always a reaction after the injection; it starts in an hour or two after the injection and there is a fever followed by severe sweating. No harm has ever followed any of these reactions.

5. *Quinine.*

It must be injected intravenously in malignant malaria. Ten grains of quinine bihydrochlor in 20 c.c. of water, together with 0.5 c.c. of pituitrin should be injected very slowly.

6. *Sodium Salicylas.*

In the treatment of obstinate cases of rheumatic fever the drug has been successfully employed intravenously at the new York Hospital. Thirty to sixty grains in 20 c.c. of water are given 2 to 4

times a day. The salicylate used must be pure.

7. *Strophanthin*.

It is an emergency remedy and its only method of administration is by the intravenous route. It is a most effective and sometime life-saving drug in acute cardiac failure or when the patient can not tolerate digitalis by mouth. Improvement commences within two hours and becomes quite pronounced 6 to 10 hours later. The dose is 1/130 gr. in 2 c.c. of water; it should not be repeated within 24 hours. Digitalis therapy should be commenced on the same day.

IV. SALINES, DEXTROSE ETC.

The value of intravenous infusion in cases of shock, toxemia, hemorrhage, dehydration and severe acidosis are known to all practitioners of medicine.

132 INJECTION TREATMENT IN GENERAL PRACTICE.

Infusions are best given to adults at the elbow. Isotonic or hypertonic solutions may be injected according to the indications present. Messers P. D. & Co. have put on the market tablet sodium chloride and tablet hypertonic (Roger's) which are quite convenient for use.

The fluid may be run from a glass transfusion apparatus through a large needle or the vein may be exposed by an incision at right angles to its course and a cannula tied in. The temperature of the fluid should be about $105^{\circ}f$ and effort should be made to keep it constant throughout the procedure. The fluid should be run in slowly about 1 pint in 10 to 15 minutes. The following special applications of this form of therapy are deserving of a brief description.

NORMAL SALT SOLUTION IN UPPER INTESTINAL OBSTRUCTION.

The cause of death in upper intestinal

obstruction where there is a continued loss of digestive secretions from vomiting, is a rapid withdrawal of fixed base (chiefly sodium) and of chloride ion from the body. This is accompanied by a corresponding extensive reduction in the volume of the blood plasma.

There also occurs, depending on the relative amounts of sodium and of chloride ion lost, an alkalosis or an acidosis of varying degree. The most persuasive evidence that dehydration can be a directly fatal condition is the fact that death can be prevented by administration of sufficient quantities of isotonic saline. It should be remembered that the treatment is applicable to simple blockage high in the intestinal canal where free drainage of secretions into stomach is possible—a relatively infrequent type of obstruction.

REDUCTION OF INCREASED INTRACEREBRAL PRESSURE BY DEXTROSE.

Immediate relief from symptoms is obtained by the intravenous injection of 100 c.c. of a 50 per cent solution of dextrose in cases of trauma to the head. The injection may be repeated as often as three times in 24 hours. The treatment is indicated in all head injuries regardless of whether shock is present or not. Urine should be examined for sugar before injections and if sugar is present insulin should be injected also. It is also a valuable preoperative measure for relieving intracranial tension and headache when a decompression operation on the skull has been decided upon.

CHAPTER X.

SCIATICA.

Sciatica may be classified as follows:—

A. Primary or idiopathic sciatica in which no obvious causative factor is discoverable.

B. Secondary sciatica which is dependent upon some gross pathological lesion. The causes of secondary sciatica may be divided into local and constitutional.

LOCAL CAUSES.

The local causes may affect the nerve fibres in either of the three situations, the nerve roots, the plexus or the trunk of the nerve. When the roots are involved the causal factor may be a meningitis specially syphilitic, a dislocation or fracture of the vertebræ, Pott's disease, new growth of the bones or meninges, arthritis deformans or Pagets' disease. When the sacral plexus is involved the cause may lie in an extension of infection from

any of the pelvic organs, or it may be a pressure effect of an exudate, a growth, a foetal head, a displaced uterus or even a foecal accumulation. In its course through the thigh and the leg the nerve is exposed to infection, inflammation, injury and operative interference. Dislocation, sprain, relaxation or inflammation of the sacro-iliac joint should also be borne in mind.

CONSTITUTIONAL CAUSES.

Among others the following should be considered:—

(a) Infections *e.g.* puerperal fever, typhoid, influenza, gonorrhoea and rheumatism.

(b) Intoxications *e.g.* alcoholism, lead and arsenic poisoning.

(c) Metabolic disorders *e.g.* gout and diabetes.

Sicard classifies primary sciatica as:—

(a) Radiculitis when posterior nerve root within the theca is involved;

(b) Funiculitis when the part of the root involved lies between the ganglion and the plexus;

(c) Plexitis when the plexus is involved;

(d) Trunculitis when the nerve trunk itself is the seat of the morbid process; and

(e) Neuritis or peripheral neuritis when part affected is beyond the trunk.

Radiculitis and funiculitis constitute sicard's high sciatica. Middle sciatica includes neuritis of the plexus and the nerve trunk and the peripheral neuritis of the sciatic nerve as far as its entry in to the popliteal fossa. Inflammation of the nerve in the popliteal fossa or below it, is Sicard's low sciatica. Sicard is of opinion that in a large number of cases sciatica is a funiculitis of the last two lumbar and the first two sacral roots.

For rational treatment of sciatica it is of the first importance to first determine the site of the pathological process. The following table brings out the principal diagnostic features of radiculitis, funiculitis and trunculitis.

No.	RADICULITIS.	FUNICULITIS.	TRUNCULITIS.
1.	Lymphocytosis in c. s. fluid	No lymphocytosis but hyperalbuminosis to the extent of 0.1 percent or more.	No lymphocytosis but hyperalbuminosis present.
2.	Pain is commonly bilateral, may also be felt in distribution of femoral or other lumbar nerves. Sometimes hyperesthetic areas corresponding to the affected roots are present.	Pain typically sciatic.	Pain unilateral usually.

TREATMENT.

Injection treatment is resorted to, in cases where the ordinary measures *i.e.*, rest in bed, heat and analgesics fail. The treatment is more suitable in subacute and chronic cases though acute cases have also been treated successfully. In middle and low sciatica injections of the nerve trunk and in the last resort epidural injections are indicated. In high sciatica Cathleen's epidural injections are made from the very start.

Epidural Injection.

APPARATUS.

1. A lumbar puncture needle with a small bore or an ordinary stout needle $2\frac{1}{2}$ inches long.
2. 20 c.c. syringe.
3. Alcohol, cotton wool, collodion etc.

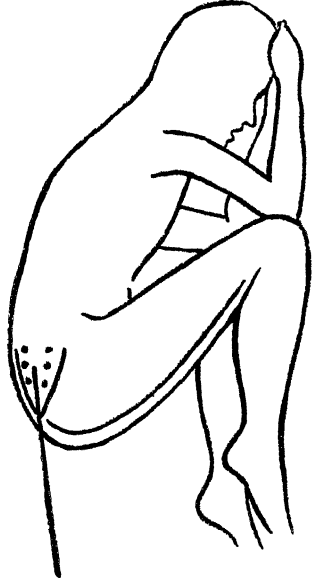


Fig. 9. --Knee elbow position for epidural injection.

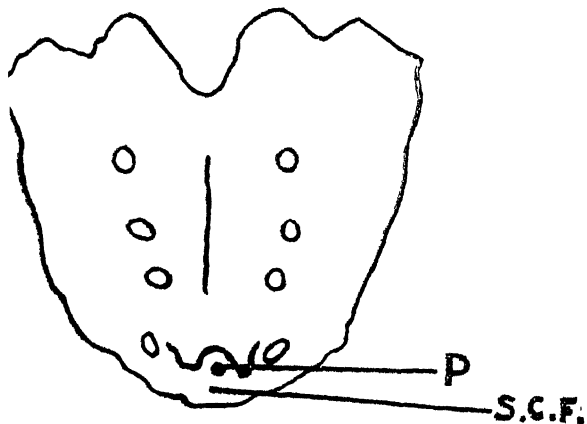


Fig. 10.—Point P. indicates the position for entering the needle.

S. C. F.—Sacro-coccygeal foramen.

SOLUTION.

1. A forty percent solution of anti-pyrene.

2. 20 c.c. of a one percent solution of novocaine followed by 60 c-c. of sterile normal saline.

TECHNIQUE.

The patient is placed either in the knee chest position or on the affected side with the thigh flexed. The skin is sterilized with tincture of iodine. A lumbar puncture needle with a small bore or an ordinary stout needle $2\frac{1}{2}$ inches long is inserted between the two lateral tubercles of the sacrum and in line with the superior median protuberance. These prominences are as a rule visible and can be made out by palpation. The needle enters perpendicularly until the sacro-coccygeal ligament is pierced when it is pointed upward at an acute angle, so as to enter the sacral canal

without penetrating the dura. The depth of insertion is from $1\frac{3}{4}$ to 2 inches. A 20 c.c. syringe is attached and 10 to 20 c.c. of a 40 per cent solution of anti-pyrene injected. Another effective solution is 20 c.c. of a 1 per cent novocaine solution followed by 60 c.c. of sterile normal saline. The needle is withdrawn and the puncture sealed with collodion. The patient remains in bed for 24 hours following the injection. If the pain recurs after a remission the injection can be repeated.

INJECTION INTO THE NERVE TRUNK.

It is made in subacute or chronic cases of sciatica when the seat of neuritis is below the plexus, that is to say when it is a trunculitis or a peripheral neuritis.

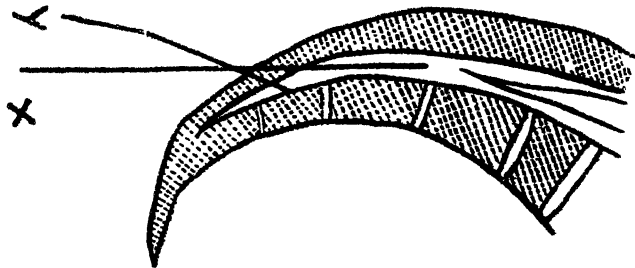


Fig. 11.—

Y.—Needle in the wrong direction.

X.—Needle rightly placed.

SOLUTION EMPLOYED.

Schlosser, in 1904, introduced the injection of alcohol in the treatment of trigeminal neuralgia. The treatment was taken up for cases of sciatica also and promised to be very successful. Sciatic, however, being a mixed nerve, the risk of causing a permanent paralysis—not small—had to be considered. Alcohol was therefore abandoned and its place taken by the harmless normal saline solution of Lange. Novocaine may be added to the solution. The following is a very satisfactory formula:—

R.

Novocaine	...	gr. 1½
Normal saline	...	60 c.c.

The salt solution is sterilized by boiling for half an hour, novocaine is added and the whole boiled again for a moment before use. The dose injected, is 40 to 100 c.c. the average amount being 60 c.c.

LAND MARKS.

The best place to get the nerve is where it passes over the spine of ischium; this is also the highest accessible point on the trunk of the nerve. A line is drawn from the middle of sacrococcygeal junction to the upper end of the postero—external border of the great trochanter. A point on this line lying one inch external to the junction of the inner and middle thirds is selected. This point lies perpendicularly over the ischial spine and is marked with a skin pencil for the insertion of the needle.

TECHNIQUE.

The patient lies on the abdomen with the thighs and the knees extended. The skin of the buttock on the affected side is sterilized with the tincture of iodine. The selected point and the tissues below it are anesthetized with novocaine solution. A strong needle at least four inches long is then sterilized by boiling.

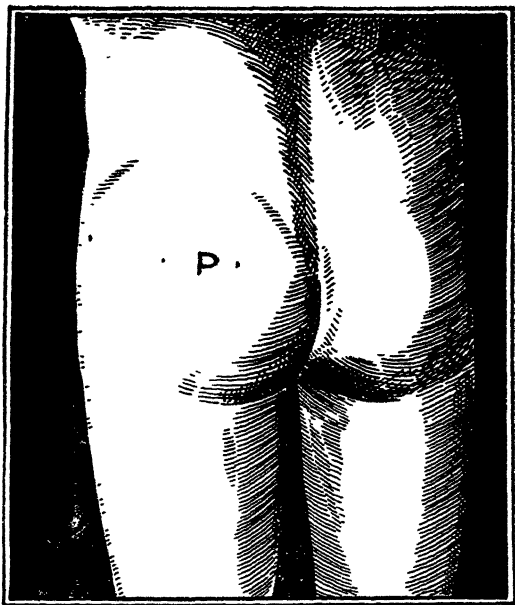


Fig. 12 —Point P, situated 1" external to a point separating the inner third and outer two-thirds of the line marks the point of puncture.

The needle should be bevelled but not very sharp. It is slowly inserted perpendicularly to the surface. A characteristic shooting pain in heel or along the course of the nerve is felt as soon as the nerve is reached. A sterilized syringe holding 60 c.c. of the solution is attached to the needle and the injection made slowly but steadily. The needle is withdrawn and the puncture sealed with collodion. Immediate relief from pain is obtained in a considerable proportion of the cases. Local pain, tenderness and a slight fever may follow the injections. A dose of aspirin and local application of heat is all that is necessary. A single injection may be sufficient but in more resistant cases two to five have been necessary.

CHAPTER XI.

TRIGEMINAL NEURALGIA.

It is an affection of the fifth cranial nerve for which no pathological basis is discoverable. There are changes neither in the nerve itself, nor in its ganglion or the deep connections. Its chief characteristic is a paroxysmal pain which is usually also unilateral. Between the paroxysms the relief from pain is complete. Tenderness over the branches of the nerve is common during attacks of pain.

Of the true cause of trigeminal neuralgia we do not know anything. We have therefore to consider a great many possible causes both local and Systemic. Of the local causes the most important are to be sought in the teeth. The nose, the sinuses, the eyes and the ears should be investigated in every case. More important than the local causes are,

however, the systemic ones. Debilitating disease, anemia, arteriosclerosis, rheumatism, gout, diabetes and specific infections are a few of the many that should be borne in mind. Among acute infections the first place belongs to influenza and among chronic diseases malaria and syphilis often stand in causal relationship.

TREATMENT.

If any local or constitutional cause is discoverable it should first be dealt with adequately. The patient's general health is improved by dietetic or hygienic measures and by tonic medicaments as iron and arsenic. Gelsemium in 10 to 20 minim doses three times a day is often very useful. Liebreich strongly recommends butyl chloral hydrate as follows:—

R.

Butyl chlorali	...	<i>ʒi</i>
Glycerinæ	...	<i>ʒiv</i>
Alohalis	...	<i>ʒiv</i>
Aqua, q. s. ad	...	oz. 2

Label. A tea spoon in water every ten minutes until relieved or six doses are taken.

Analgesics of the coal tar series such as aspirin, phenacetin, antipyrin are of great value and should be given a sufficient trial. Locally soothing measures such as warmth etc., are grateful. Where these agents fail and opiates are regularly required to alleviate pain it is time to think of more radical measures.

INJECTION TREATMENT OF TRIGEMINAL NEURALGIA.

In 1903 Schlosser introduced a method of injecting the branches of the trigeminal nerve with alcohol. The injections are made under local anesthesia, the anesthetic employed being 2 per cent novacain in a Ringer's solution. A few drops of 1 in 1,000 adrenalin chlor. are also added.

The solution employed is 90 per cent alcohol.

Injections at the Foramina of the Face.

SUPRAORBITAL FORAMEN.

The supra orbital notch is situated at the junction of the inner with the outer two thirds of the upper margin of the orbit. After sterilising the skin with absolute alcohol the notch is felt through the upper margin of the upperlid. With the index finger of the left hand at the notch a hypodermic needle is inserted into it from below upward with the other hand. The left index finger acts as a land mark for the needle as well as prevents its going into the orbit. As soon as the nerve is pierced the patient feels a characteristic pain on the vertex. A charged hypodermic syringe is attached and 10 drops of the anesthetic injected. The syringe is now detached and the needle left in situ. After an interval of five to ten minutes 10 to 15 drops of alcohol are injected.

INFRA-ORBITAL FORAMEN.

A line is drawn from the Supra orbital notch to the second bicuspid tooth. The infra orbital foramen lies on this line about 8 m.m. below the lower margin of the orbit. The foramen is located with the left index finger which also prevents the needle from entering the orbit. The needle is inserted into the canal obliquely, the syringe resting on the alar nasi and the point directed upward as well as outward and backward. When the nerve is pierced the patient feels a peculiar pain in the nose, the upper lip and the incisor teeth. Ten drops of novocain are injected and ten minutes later with the needle in situ 10 to 15 drops of alcohol. If there is difficulty in finding the foramen two to four c.c. of alcohol are injected on to the surface of the bone at different points surrounding the foramen.

THE MENTAL FORAMEN.

The mental foramen lies opposite the

root of the lower second bicuspid and on a line joining it to the supra orbital notch.

The needle is entered from behind and outside this point in a downward, inward and forward direction. Injection here will relieve neuralgia of the third branch especially when the lower lip is affected.

Injections at the Cranial Foramina.

Injection of the second or the Maxillary Division.

APPARATUS.

- (1) A graduated needle 7 cm. long similar to a fine lumbar puncture needle.
- (2) A 2 c.c. syringe with needle.
- (3) Ninety per cent alcohol.
- (4) Two percent novocain Solution.
- (5) Skin marking Pencil.

TECHNIQUE.

The posterior edge of the frontal

process of the malar bone is marked with a skin marking pencil. From this point a perpendicular is drawn downwards and where it crosses the lower border of the zygoma a mark is placed. In normal skulls this mark is just in front of the coronoid process of the mandible. The needle is inserted at this point transversely. Its direction is neither forward nor backward but upward at such an angle that at a depth of 5 c.m. the point of the needle will be on the same horizontal plane as the lower end of the nasal bone and about 3 m.m. below the floor of the orbit. It passes between the superior maxilla and the external pterygoid plate into the spheno—maxillary fossa. At a depth of about 5 c.m. if the direction of the needle is correct the point impinges on the superior maxillary branch where it leaves the foramen rotundum. A characteristic pain is now felt in the nose, upper lip and upper teeth. The operator makes sure that

there is no blood from the butt of the needle. A few drops of novocaine are injected and at the end of one minute a test for anesthesia made over the nose and the cheek.

If there is no diplopia or other sign of disturbance within the orbit, after allowing ten minutes for the absorption of the anesthetic, one c.c. of alcohol is slowly injected.

COMPLICATIONS

- i. Hematoma Formation.* A pad should be place over the point of puncture and pressure applied for at least 10 minutes.
- ii. Herpes.*
- iii. Trophic Disturbances* in the eye, such as corneal ulcer may follow. The injection of the anesthetic should always precede that of alcohol and the latter only made

if there is no disturbance in the orbit.

Injection of the third division.

APPARATUS.

Same as in the injection of the second division.

TECHNIQUE.

A point is marked at a distance of one inch from the external auditory meatus between the lower border of the zygoma above and the mandibular notch below. After surgically cleansing the place a little novocaine is injected into the skin and as deep as a hypodermic needle will permit. The long needle is now inserted transversely, a little upward and backward. At a depth of about 4 c.m. the needle reaches the nerve just below the foramenovale. Levy and Baudouin suggest the following alternative method. The needle is inserted at the point indicated, but pointed slightly forward

and upward. In this way it is always arrested at about 3.5 c.m. by the bony surface which forms the cranial origin of the external pterygoid plate. It is necessary to go further back, but this can not be done without withdrawing the needle some millimetres, in order to free it from the fibres of the external pterygoid muscle. The point is then slightly inclined backward and again pushed inward. If the same bony wall is again encountered, the manœuvre must be repeated. But soon the needle is felt to clear the posterior border of the external pterygoid plate and sink deeper. It is now in the right place, either in line with the foramen ovale or immediately in front of it. This technic requires a strong resistant needle.

As the nerve is reached a characteristic pain is felt in the tongue, cheek and lower jaw. A few drops of novocaine are injected and a test for anesthesia

made. If no blood appears at the butt end of the needle, after waiting for ten to fifteen minutes one to one and a half c.c. of alcohol are injected. The needle is withdrawn and the point of puncture sealed with collodion.

COMPLICATIONS.

The complications attending the operation are:—

(1) Sepsis. Its likelihood is small if the point of puncture, the operators' hands, the instruments and the solutions are surgically clean.

(2) The injection has been made into the middle ear causing great damage.

(3) Paralysis of the sixth nerve.

(4) Paralysis of the motor root of the trigeminus.

The last three complications should not occur if proper attention is paid to

the surface anatomy of the skull and the operation first attempted on the cadaver.

Should, however, injections be impossible owing to peculiarities of the individual skull, expert surgical aid should be sought, for division of the fifth nerve proximal to the gasserian ganglion.

CHAPTER XII.

NON-SPECIFIC PROTEIN THERAPY.

Non-specific protein therapy has been variously described as "the ordeal by chill and fire," "protein shock therapy," or "pyrogenic therapy." It was first introduced by Miller who together with Lusk is one of its greatest exponents today. In making use of this form of therapy in the treatment of disease it is wise to familiarise oneself thoroughly with one or two agents only, and to try to know all about their mode of administration, dosage and reactions etc.

Mechanism of Action.

Exactly how non-specific agents bring about amelioration in specific diseases we do not know and to explain the *modus operandi* a large number of theories have been from time to time suggested. Paultauf was of opinion that the beneficial effect of non-specific agents was due to

the pyrogenic substances in the proteins employed. Gay and Claypole considered that the benefit was due to the leucocytosis that followed the injections. Hermann demonstrated that specific antibodies which the antigen previously injected could not liberate were set free on injection intravenously of foreign protein. Weichardt ascribed the benefit to a general stimulation of the cellular elements of blood and other tissues causing an increased production of specific substances. Pemberton attributed the effect to an increased breakdown of glycogen. Mackenzie and Frubauer showed that egg antibodies disappeared from the circulating blood of rabbits some time after they had been given the white of an egg. These antibodies reappeared when typhoid vaccine was administered parenterally. To this process of reawakened immunity to which they gave the name "anamnesic reaction," they attributed the beneficial effects of treatment.

It is very likely that more than one of these theories is correct and that several act in conjunction to explain the mechanism of action.

INDICATIONS.

Non specific protein therapy is indicated in localized rather than generalized infections and only where specific measures are either not available or prove to be a failure. The principal conditions where this form of treatment may be used with benefit are:—

I ARTHRITIS.

The treatment is employed both in acute and chronic forms of arthritis. In acute cases in about 70 per cent of the cases there is marked improvement. Discomfort and pain disappear in two to three injections. The results are permanent in approximately forty per cent. In chronic arthritis, cases that get the benefit belong to the rheumatoid arthritis group. The degenerative arthritis of old

age, the menopausal arthritis and the traumatic or osteoarthritis do not receive any benefit. T. A. B. Vaccine, administered intravenously is the usual agent employed but milk given intramuscularly also has its advocates.

II. GONORRHOEA and its complications. Non specific measures often prove of greater value than specific measures in gonorrhoeal arthritis, prostatitis, epididymitis and salpingitis. Typhoid vaccine is again the best agent to employ.

III. ALLERGIC DISEASES.

The best treatment is to determine the cause and if possible to try to eliminate it. Where it is not possible to do the latter, specific desensitization should be attempted. Only when the cause can not be found or eliminated or when desensitizing measures fail, should non-specific treatment be instituted.

1. *Asthma and Hay fever.*

Auld introduced peptone in the treatment of asthma. Witte's peptone no. 30, administered intravenously or intramuscularly is the best to use. Van Leeuwen treats asthma by injections of tuberculin. He begins with 0.1 c.c. of a one in a million dilution of old tuberculin, the dose being increased daily or on alternate days. Bray is of opinion that the beneficial results obtained with tuberculin are of very short duration and the cases relapse very soon.

Schiff injects whole milk sterilized by boiling for half an hour intramuscularly. He commences with 0.5 c.c. and increases the amount each time by 0.5 c.c. till a dose of 3 c.c. is reached. Injections are given on alternate days.

2. *Migraine.* Peptone injections are sometime successful.

3. *Urticaria and Angioneuritic Oedema.* Autohemotherapy and autoserotherapy often succeed where all other measures have failed. Blood is withdrawn from a vein at the bend of the elbow and after defibrination, injected subcutaneously or intramuscularly. Injections are repeated every day, the dose being from half to two c.c. When fresh serum is used the injections are given on alternate days; the treatment is commenced with 2 to 4 c.c. and the dose is gradually increased to 10 c.c.

4. *Eczema.* Typhoid vaccine and milk have both been tried and found wanting. Beneficial results have been reported by a number of observers in the eczema of adults only, from injections of blood. In infants auto-hemotherapy has proved a failure.

5. *Psoriasis.* Autoserotherapy has been used with considerable benefit in a number of cases. Other observers

have obtained good results from use of horse serum and typhoid vaccine.

IV. OCCULAR AFFECTIONS.

Muller and Thanner claim to have very good results from the use of milk injections in the treatment of iritis and gonorrheal ophthalmia. In Allen's opinion injections of T. A. B. vaccine are superior to milk injections. Good has often followed the use of protein injections in the use of conjunctivitis, keratitis, corneal ulcers, choroiditis and retinitis.

V. FURUNCULOSIS, CARBUNCLE AND ERYSIPELAS.

A number of cases have been treated by intramuscular injections of milk. The results are very encouraging.

VI. NERVOUS AND MENTAL CONDITIONS.

Injections of peptone have brought relief in a number of cases of migraine. Pyrotherapy has been used extensively

in the treatment of nervous syphilis particularly general paralysis of the insane. Previous to introduction of Von Jauregg's malarial therapy, typhoid vaccine, tuberculin and other agents were employed to induce pyrexia. Whatever the agent employed benefit results in from 30 to 40 per cent of the cases. Beneficial results are also reported in neuritis, Raynaud's disease and thrombangitis obliterans.

AGENTS EMPLOYED.

I. Whole Blood.

It may be injected citrated or untreated either hypodermically or intra-muscularly. The dose is 10 to 50 c.c.

II. Serum.

Autoserotherapy has been employed with considerable success in a number of dermatological conditions. The dosage

and the technique have already been indicated. Animal sera both normal and immune have also been tried from time to time, but not with very encouraging results.

III. Proteins of animal and vegetable origin and their products.

(a) Those derived from animals.

Fresh cow's milk is obtained and kept at boiling point for 4 minutes. It is then cooled to body temperature and strained through sterilized gauze. The treatment is commenced with 2 to 5 c.c. given intramuscularly twice or three times in a week and the dose is increased by 1 to 2 c.cm. every time till a maximum of 10 c.c. is reached. Care should be taken that the injections are not made into a blood vessel as fat embolism may occur. Milk is marketed in ampoules ready for injection under the proprietary names of lactolan (Calcutta research) Lactumin

(Bengal chemical) and Aolan.

Among other agents of this class are egg-albumin and gelatin. Egg-albumin is used as a 5 to 10 per cent solution and gelatin as 1 to 2 per cent solution. Both are used subcutaneously and the dose is from 5 to 10 c.cm.

(b) Those derived from vegetable kingdom.

Nucleic acid and nucleins have been used to stimulate leucocytosis and antibody formation. Gardner-Medwin claimed good results from the use of sodium nucleinate in the treatment of pneumonia. He employed 10 c.c. of a 5 per cent solution and injected it subcutaneously or intramuscularly. Other observers are not as enthusiastic as Medwin.

(c) *Split products.* To this group belong the proteoses, peptones and histamine. Proteoses are prepared from

milk, wheat, gelatin or fibrin and $\frac{1}{2}$ to 2 c.cm. of a two to ten per cent solution is injected every day. A mild reaction is the aim and a dose is selected that will just produce it. Miller and Lusk obtained good results in typhoid fever by injecting 1 to 2 c.cm. of a 4 per cent solution intravenously. Other observers have reported beneficial results in the treatment of chronic arthritis.

When it is proposed to employ peptones, Armour's or Witte's peptone should be selected. Five to ten cubic centimeters of a 10 per cent solution are injected intravenously. Benefit is reported in arthritis, hemorrhagic diathesis and septicemia. In the treatment of allergic diseases, however, the dosage employed and the method of administration are slightly different. Treatment is commenced with 5 minims of a 5 to a $7\frac{1}{2}$ per cent solution, 5 per cent when the intravenous route is selected,

7½ per cent when it is intended to be given intra-muscularly. Auld recommends a five per cent solution of Witte's new "peptone special 30," which is devoid of the toxic effects of ordinary peptone. Two doses are given in the week and the dose is increased by 3 minims every time until a dose of 40 minims is reached.

Bray has been using histamine in the treatment of allergic diseases. Histamine or a similar substance is supposed to be formed at the site of allergic reactions. Its antagonist in the body is adrenaline and injections of histamine probably stimulate secretion of adrenaline. The treatment is commenced with a tenth of a milligram and the dose is increased by a tenth of a milligram every day or week until a milligram dose is reached.

IV. Bacterial Products.

Vaccines. The one most commonly employed is the typhoid vaccine or the mixed typhoid and paratyphoid

vaccine. The treatment is commenced with a dose of 25 million organisms and the dose is increased by 10 to 15 millions every time for five injections. The injections are made twice weekly into a vein.

Miller and Lusk, Cecil and numerous other observers have employed it extensively in the treatment of arthritis, and the reported results are very favourable. Beneficial results are also reported from its use in the treatment of gonorrheal complications, syphilitic paresis and multiple sclerosis. In multiple sclerosis two courses of 10 to 15 injections with an interval of three months between the courses lead to a certain amount of improvement in the condition.

Extracts. Van Leenwen who introduced tuberculin in the treatment of asthma reports favourably upon its use. Other observers, however, are not so enthusiastic about it.

V. Tissue Extracts.

Dealbuminized splenic extract has now been used for some time in the treatment of tuberculosis and allergic conditions. In tuberculosis 5 c cm. of a 20 per cent solution are injected subcutaneously and twelve injections made over a period of 18 days. In allergic conditions 5 c cm. of a 40 per cent solution are injected hypodermically on alternate days for 12 injections. Good results are also reported from the oral use of the extract.

Contra-indications. P. S. Hench lists these as follows:—

1. Marked arteriosclerosis, renal or peripheral.
2. Un-compensated cardiac, renal or vasomotor disease.
3. Chronic infections of long

duration, with dissemination to several sites.

4. States of exhaustion following prolonged illness.
5. Pulmonary tuberculosis, active or quiescent.
6. Conditions in which hemorrhage may occur, such as hemo-philia, and in the ulcerating stage (third week) of typhoid fever.
7. The period within 14 days after an operation, for hemorrhage has occurred in such cases.
8. Marked hypertension.
9. Chronic alcoholism for fear of delirium tremens.
10. States of grave nervous instability, quiescent or active, such as hyperthyroidism, epilepsy and psychopathic conditions other than

CHAPTER XIII.

TUBERCULIN TREATMENT.

More than forty years have elapsed since koch first announced the discovery of tuberculin. In spite of this authorities are not agreed either on its therapeutic uses or the dangers which may follow its use. Some still hail it as a specific, others denounce it as positively harmful. R. A. Young assessing its present position states that tuberculin has a definite though limited value in certain types of cases. Fishberg, in the recent edition of his admirable book joins the ranks of those who advise against its use.

SELECTION OF A TUBERCULIN.

All the tuberculins may roughly be divided into three groups:—

- I. Those prepared from the culture media in which tubercle bacilli have grown; to this class belongs koch's Old Tuberculin O. T.

- II.* Those prepared from tubercle bacilli themselves; the best representative is koch's Bacilli-emulsion: B. E.
- III.* Those prepared by various methods of extracting the tubercle bacilli; principal member of this class is koch's New Tuberculin: T. R.

SELECTION OF PATIENTS.

1. The most suitable patient is one with a localised lesion that is not producing constitutional symptoms. The treatment is, therefore, applicable in early pulmonary tuberculosis and in disease of the glands, bones and joints etc.
2. Patients exhausted by disease, advanced cases with fever and emaciation and milliary tuberculosis are definitely made worse.

Since the treatment is used only in a-febrile cases and those with localised lesions, cases that may improve with hygienic treatment alone and without tuberculin, it is difficult to disprove the testimony of those who oppose its use in any type of case.

ACTION OF TUBERCULIN.

R. A. Young emphasizes the fact that tuberculin is perfectly harmless in persons not suffering from tuberculosis. In the infected persons, however, its toxic effects are produced. Some observers believe that tuberculin acts in a specific manner. There are others who attribute the tuberculin reaction to the protein content of the agent and opine that it acts like any other non-specific foreign protein as for example milk or peptone.

DOSAGE AND METHOD OF ADMINISTRATION.

There is no agreement either about its initial dose, or the subsequent dosage.

Bandelier and Ropke recommend a dose of 1 mg. Philippi on the other hand is of opinion that the initial dose should not exceed 0.0000005 mg. Between these two extremes numerous quantities are suggested. Many pharmaceutical houses have put on the market tuberculin in proper dilutions ready for use. But for those who prefer to make their own dilutions and to ensure stability the technique is as follows:—

Ten amber coloured bottles of 20 c.c. capacity are cleaned and sterilized. Each bottle is filled with 9 c.c. of 0.8 per cent sterile sodium chloride solution to which 0.5 per cent of carbolic acid is added. The bottles are numbered from one to ten. To bottle No. I is added 1 c.c. of tuberculin,—Old tuberculin, O. T., for treatment of tuberculosis of glands, bones and joints etc. and bacillary emulsion, B. E., for treatment of pulmonary tuberculosis. Bottle No. I, therefore, contains a 1 in 10 dilu-

tion of tuberculin. After thoroughly shaking the contents of bottle No. I, 1 c.c. of fluid is transferred from it to bottle No. II, which therefore contains a 1 in 100 dilution of tuberculin. The process is repeated from bottle to bottle till bottle No. X is reached. Fishberg, who thinks and perhaps rightly that reactions are injurious, recommends that the first injection should be made from bottle No. X, which contains 0 0000001 c.m.m. of tuberculin per c.c. One tenth of the contents of a 1 c.c. tuberculin syringe are injected the first time and the dose is increased by 0.1 c.c. every time. Injections are made twice a week. According to Fishberg the final dose should not exceed 0.001 c.m.m., that is to say, 1 c.c. from bottle No. VI. The injection of a higher dose, he thinks is "playing with fire." Tuberculin may be injected hypodermically below the shoulder blades or in the region of the flanks or upper arm. Should a reaction

occur the interval between the doses must be increased to eight days and no increase made in the subsequent dose.

DANGERS.

Most physicians who employ it advocate its use in a-febrile pulmonary cases or in diseases of the glands, bones and joints. It is not a suitable agent to employ in cases of advanced disease, in febrile cases and in those in whom the toxic symptoms are greater than is warranted by the extent of the lesion. In such as these it may do irreparable damage. Its chief dangers are activation of quiescent foci, generalization of disease and occurrence of pulmonary hemorrhage due to hyperemia of the affected lung.

CHAPTER XIV.

ARTIFICIAL PNEUMOTHORAX.

The principle of pneumothorax treatment originated with James Carson of Liverpool nearly one hundred and twenty years ago. He even induced a couple of patients including one Mr. Sloane to undergo the treatment. Forlanini of Pavia was the first, however, to induce a successful pneumothorax for therapeutic purposes. Saugman added simplicity and safety to the procedure by supplying the manometer which is in fact the very heart of the apparatus.

RATIONALE OF TREATMENT.

Rest is a factor of first importance in the treatment of tuberculosis in all its forms. As in tuberculosis of a joint so also in pulmonary tuberculosis rest promotes healing. By inducing pneumothorax we secure to the diseased lung rest that would not otherwise be possible

for an organ making approximately one thousand respiratory excursions in a single hour. But pneumothorax treatment of a tuberculous lung achieves more for it than is explicable on the basis of mere rest. Coryllos of New York reminds us of the fact that virulent human or bovine tubercle bacilli, not only are strict ærobes but need a large amount of oxygen for life and growth. He believes that artificial pneumothorax by producing kinks in the bronchus draining a cavity occludes its lumen. In a closed cavity the contained air is absorbed and a condition of anærobiosis set up. This produces marked biologic changes in the development of the tubercle bacilli. As a last point he emphasizes the close relationship between tissue anoxemia present in tuberculous cavities and fibrosis. According to him then, collapse therapy benefits a tuberculous lung in the following three ways:—

1. It secures rest for the diseased

part.

2. It causes oxygen deprivation of the bacilli.
3. It promotes fibrosis of the anoxic tissues.

INDICATIONS.

These may be divided under two heads:—

Tuberculous disease of the lung and non tuberculous disease of the lung.

A. TUBERCULOUS DISEASE OF LUNG.

1. *Unilateral Cases.* The best cases for therapeutic pneumothorax are those in which the disease is limited to one lung only. The exudative type is more suitable than the fibrotic type. The really early case with subclavicular infiltration situated in the midst of a healthy lung parenchyma and without any adhesions,

is in fact the ideal one. But such cases often get well under the usual hygienic and dietetic regime. In every case of this type, therefore, local treatment should be instituted only when the disease shows no sign of amelioration after several weeks of rest and routine treatment.

In unilateral apical disease, cases with exudative disease do well. Patients with apical disease of some year's standing, have sclerotic lesions that often improve on routine treatment alone. What is more, in such cases there are adhesions present that prevent the induction of a successful collapse.

In adolescent acute phthisis a young person in teens develops an acute febrile illness. In the course of a couple of weeks or so, definite signs develop in the lung and tubercle bacilli are found in the

sputum. A large number of these cases rapidly end in death in spite of all treatment but some make a marvellous recovery when artificial pneumothorax is commenced.

Patients with fibroid disease of a lung rarely benefit by pneumothorax treatment. This is due to adhesions preventing an effective collapse as well as to emphysema present in these cases and increasing the existing dyspnoea.

2. *Bilateral Disease.* The unilateral case is undoubtedly the ideal one to treat by this method. But apart from really early case with symptoms only of malaise and an occasional after-noon rise of temperature to 99°f ,—a case in which no physical signs are discoverable but radiological examination alone reveals an infra-clavicular opacity,—tubercular disease of the lung if of any stand-

ing is rarely strictly unilateral. Experience tells us that in a large number of cases of moderately advanced disease the lesion is extensive and active in one lung, while in the other lung the disease is either very limited or quiescent or healed. When in such cases the worse lung is collapsed, lesions in the untreated lung also improve. In some cases, however, the disease in the untreated lung flares up and shows signs of extension. The treatment is, therefore, applicable in cases of bilateral disease when the lesion in the better lung is of a limited extent and improves as the treatment is applied.

Even in far advanced disease, Forlanini and others favour pneumothorax treatment on the principle that "there is nothing to lose and every thing to gain "

3. *Hemoptysis.* Collapse of the bleeding lung will check hemoptysis more certainly than any other measure. It is not necessary to introduce more than 300 or 400 c.c. of air to achieve this end. Sometimes, however, it is not possible to determine from which lung the blood is coming. In such cases the worse lung is collapsed and if no result is obtained air is introduced into the contralateral pleural space.
4. *Pleural Effusion.* Gas replacement of pleural effusion should be considered to prevent adhesions of visceral and parietal pleura. If this operation is not performed and the collapse not maintained a subsequent pneumothorax may be impossible.
5. *Tuberculous Laryngitis.* Improvement often follows the collapse of

the affected lung.

6. *Pregnancy.* Tuberculous women must not get pregnant. If the disease is discovered after pregnancy, the latter ought to be terminated. Where, however, the pregnancy has progressed beyond four months, unless there are contraindications present, pneumothorax treatment should be commenced.
7. *Cavities.* The treatment is indicated for collapse of cavities with excessive sputum. This may not, however, be possible owing to adherent pleura. In such cases cauterisation of adhesions may make the procedure possible.
8. *Spontaneous Pneumothorax.*

Where this is due to tuberculosis, it is advisable to keep up the collapse.

Lack of time and toxemia are listed among other indications in tuberculous individuals.

B. NON-TUBERCULOUS DISEASES OF THE LUNG.

1. *Bronchiectasis.* Bronchiectatic lesions are usually situated in a dense lung parenchyma which is not possible to collapse. Further difficulty is offered by the presence of adhesions which are nearly always present. In the early unilateral case, however, it has a definite place of usefulness, specially when medical measures fail and the patient is toxemic and continues to bring up large quantities of offensive sputum.
2. *Lung Abscess.* Pneumothorax is bad treatment for pulmonary suppurations in view of the fact that the abscess may rupture and a pyopneumothorax result

Burrel advocates the procedure only in very exceptional cases when the abscess is deep in the substance of the lung and radical surgery more dangerous. In the more usual type of superficial abscess a two stage surgical operation is to be preferred.

3. *Dry Pleurisy.* The treatment is not indicated in a mild case. In severe cases where the pain is intractable 200 to 300 c c, of air will abolish the pain more effectually than any other measure. The pain of pleurisy due to a pneumonia or even a malignant growth is to be treated in the same manner.
- 4 *Pneumonia.* Success is claimed for pneumothorax both in the treatment of lobar and broncho-pneumonia. Dr. Coghlan who has successfully treated about

half a dozen cases recommends a first fill of 400 to 600 c.c. of air, run in slowly during the negative phase of the pressure swing cycle and with the needle clipped off during the high positive phases. A second fill of 300 to 590 c.c. is given 12 hours later and if the pneumonic process is not completely controllod, a third fill of only 100 to 150 c.c. of air may be given in another 12 to 18 hours. A preliminary injection of morphine gr. $\frac{1}{4}$ is advisable one hour before the induction. Coghlan attributes the beneficial effects of the treatment to separation of the pleural surfaces, rest of the inflamed lung and a limitation of blood flow through the pneumonic lung with a consequent decrease of anoxemia. The treatment requires a more extensive trial before it can be accepted as a

recognised mode of treatment in pneumonia.

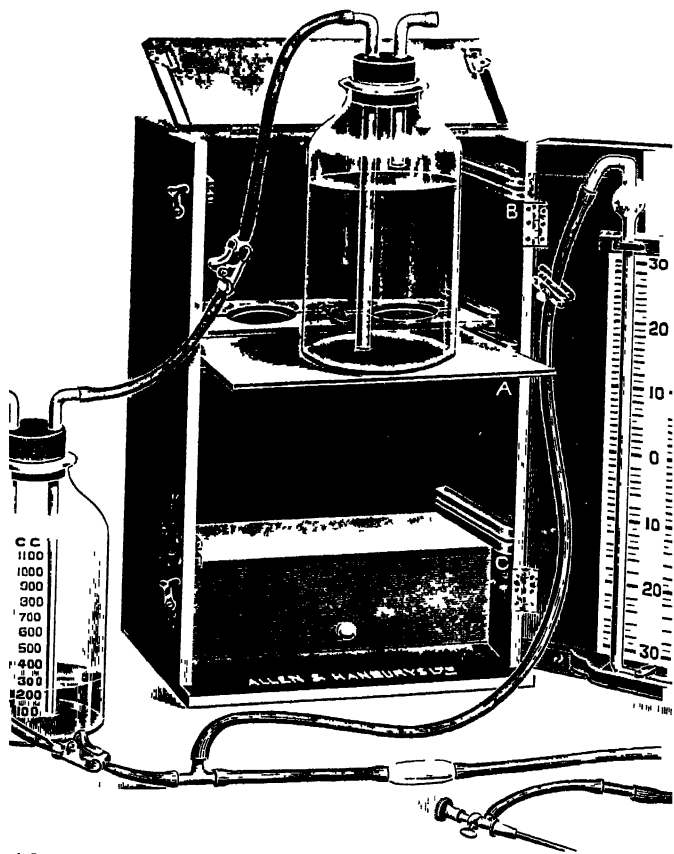
5. *Pneumothorax* is often utilised to facilitate radiological diagnosis and as a preliminary to major surgery of the chest.

CONTRAINDICATIONS.

1. *Miliary Tuberculosis* Both lungs are equally and extensively diseased and other organs are also involved. Pneumothorax treatment is useless.
2. *Acute and Subacute Caseous Bronchopneumonic Phthisis.* Patches are scattered throughout both the lungs and collapse treatment is of no avail.
3. *Fibroid Phthisis* with extensive pulmonary emphysema.
4. *Intestinal Tuberculosis* is aggravated by artificial pneumothorax

and collapse should not be attempted in those suffering from it. On the other hand if diarrhoea is caused by a mere toxemia, improvement follows the induction of a pneumothorax. Fishberg recommends that a case with mild intestinal symptoms, if there are no other contraindications, should receive a trial of the treatment.

5. *Intercurrent Disease.* Patients with concomitant disease of the heart, blood vessels or kidneys do not bear the treatment well.
6. *Age and Sex.* Better results are obtained in adolescent patients than in those over thirty five years of age. The results are often poor in patients over 45, in view of the fact that in them the disease is of the fibroid variety.



13.—Artificial Pneumothorax Apparatus Pearson Lillingstons.

Treatment is not recommended for patients over 50 years of age unless other indications like hemoptysis etc. be present.

The results are more dramatic in adolescent girls than in boys. This is due to the fact that exudative lesions, more amenable to treatment, are commoner among the female sex.

APPARATUS.

Many forms of apparatus are on the market. A simple apparatus for office use is that introduced by Pearson and Lillingston. "The graduated bottle is joined by a rubber tubing to a T-shaped glass union, one branch of which is connected to a glass manometer containing water, and the other to a needle. The graduated bottle is filled with air and the other with an antiseptic solution, which by siphonage displaces the air, and drives it gently through the tubing and needle into the pleural cavity. To facilitate

required alteration of the fluid levels in two bottles, a movable shelf (A) is provided in the case. This slides into either of the grooves, (B or C) giving two different heights. Two glass filters containing sterilised cotton wool are inserted in the tubing, one between the graduated bottle and the T-shaped union, the other between this union and the needle. Two tubing clips are provided, one to stop the siphonage between the bottles, and the other to cut off the bottles from the manometer and needle. The manometer in the illustration is graduated in centimetres. In reading this, it should be noted that the pressure recorded when the water in one limb is depressed five centimetres is ten, i.e., the difference in level between the water in the two limbs."

Jousset's apparatus is simple and portable, and consists of a 100 c.c. glass syringe with a two-way cock. Air is

admitted into the syringe through one of the openings, while through the second it leaves it. A three way glass tube connects the exit opening of the syringe, the pneumothorax needle and the manometer which is a simple graduated glass tube inserted in a cylinder half full of water. After anesthetizing the skin and the subjacent tissues down to the parietal pleura with 2 per cent solution of novocaine the needle is entered, and the oscillations in the glass tube indicate when it is in the pleural cavity. Air may now be admitted. While first few syringe-fuls are injected the syringe is kept in a horizontal position and no pressure applied to the piston. The negative pressure in the pleura draws the air from the barrel of the syringe which becomes empty after about 15 respirations. When this process is repeated a few times, the pressure in the pleura approaches zero. The syringe is now turned into a vertical position but no

pressure is exerted on the piston. It is allowed to fall by its own weight. If more pressure is needed the piston may be pushed down with the fingers until the required volume of air has been introduced.

Jeoffery Marshall's apparatus (Down Bros) is also simple and portable and is easy to handle. Among other types in use may be mentioned Holmes-Wingfield apparatus, Wingfield's "The Whippet" and Heaf's apparatus.

TECHNIQUE.

The apparatus is sterilized by boiling and thoroughly dried before use. Matters are facilitated by plugging the ends of rubber tubes with sterile glass rods between the injections. This keeps the apparatus both sterile and dry. The glass filters are filled with sterile cotton wool. The ungraduated bottle (Pearson and Lillingston's apparatus) is filled with a one per cent solution of carbolic acid

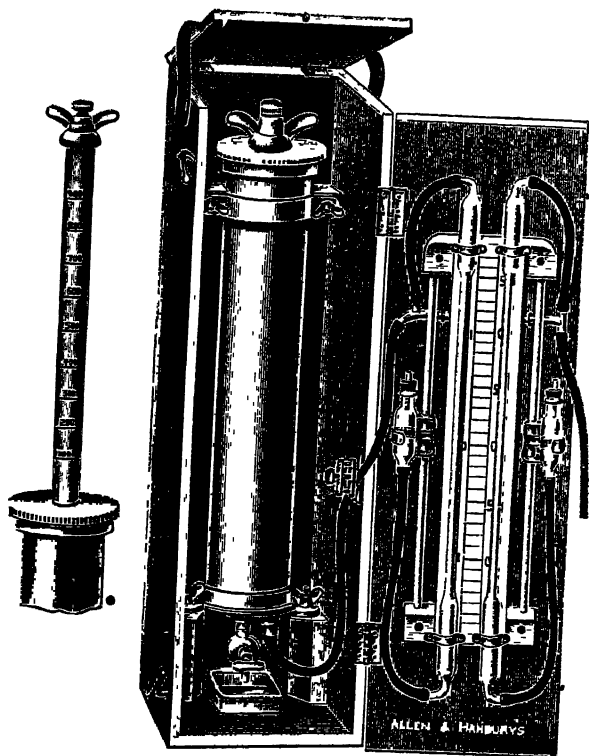


Fig. 14.—Holmes Wingfield apparatus

and the graduated one with air. Syphon action is started between the two bottles by blowing a little air from the ungraduated bottle with a Higginson syringe. For the initial fill a Cilve-Riviere needle is used. The apparatus is tested for leaks before use.

The patient lies in bed and is given an injection of gr. $\frac{1}{3}$, of Omnopon, one hour before the operation. The side to be injected is upper most and the corresponding hand is placed on the head to widen the inter-costal spaces. A pillow placed under the chest helps to the same effect. The site of election for making the injection is between the anterior and posterior axillary lines from the 4th to 6th inter-costal spaces. A complete clinical and radiological examination is, however, necessary before the site can be determined. Adhesions are frequent near the site of the disease process and effort should be made to enter away from effort should be made to enter away from

it. Several punctures are sometime necessary before a case is decided upon, as unsuitable for treatment. The selected point is made sterile by painting with tincture of iodine and the skin and the subjacent tissues down to the visceral pleura anesthetized with a 2 per cent solution of novocaine. The patient is warned not to cough during the operation. If the desire to cough is imperative the patient must be asked to inform before hand and the rubber tube joining the T-tube and the manometer pinched to prevent the fluid from being driven out of the manometer. The clip between the bottles and the one between the graduated bottle and the T-tube are closed. The clip between the T-connection and the pneumothorax needle is open. The needle is now pushed through the anesthetized skin and the muscles for about 1 cm. or even less if the patient is thin. The trocar is withdrawn and the stop cock turned. The needle is

in communication with the tube leading to the manometer. The cannula is further pushed very slowly. When the parietal pleura is reached the manometer will show an oscillation of a small extent. The cannula is pushed through the pleura which is perceived to give way with a snap. Care must be taken not to penetrate the lung. In a vast majority of patients the needle lies in the pleural cavity when it is pushed 1.5 to 2.5 cm. In some the depth is lesser than 1.5 cm. It is never more than 3 cm. When the needle is in the pleura the fluid in the distal limb of the manometer falls below zero and oscillates with inspiration and expiration. A reading is now taken and a fall of 1 cm. below zero, of the fluid in the distal limb indicates a change of pressure in the pleural space of 2 cm. of water. The oscillations must be at least 3 to 6 cm., and are sometime as great as 10 cm.

When we are certain that the needle

lies in the pleural space, the clip between the bottles and the clip between the T-tube and the bottle are opened and air admitted. Air is sucked from the graduated bottle into the pleura and fluid from ungraduated to the graduated bottle. When about a 100 c.c. of air are thus admitted the level of the ungraduated bottle may be slightly raised and another 200 c.c. of air admitted. The clip between the bottles and one between the bottle and the T-tube are again closed and a reading on the manometer taken and recorded. The needle is withdrawn from the chest and after sterilisation with iodine, the point sealed with collodion. If the initial pressures were -8 and -2 the mean initial pressure is recorded as -5 . Similarly if the final pressures were -7 and -1 , the mean final pressure would be -4 . The entire pressure changes are then recorded as follows: -5 , 300 c.c., -4 . The patient must have absolute rest in bed for the first month of treatment.

REFILLS.

The technique of administering a refill is exactly the same as that of making an initial injection. No omnopon is necessary and the needle employed is Saugman's. The principal difficulty is in determining when to give a refill and how much to inject on each occasion. This differs with each individual patient and also with climate, altitude, exercise and a number of other factors.

The collapse must be gradual, and five or six refills may be required during the first fortnight. The following examples from Burrel show pressure changes in a couple of typical cases.

1. No Adherent Pleura.

1st June.	—12—7	300	—8—5
2nd ,,	—12—7	300	—7—3
4th ,,	—10—6	400	—9—3
6th ,,	— 8—4	400	—5—2
9th ,,	— 7—5	500	—4—1

12th	„	— 6—2	400	—5—0
15th	„	— 6—2	400	—4—1

2. Some Adherent Pleura.

18th July.		—6—4	300	—5—2
19th	„	—6—4	400	—5—1
21st	„	—6—2	500	—4—1
24th	„	—5—2	500	—4—0
27th	„	—4—2	500	—2—0
31st	„	—2—1	500	—1+1
5th August		—4—2	600	+1+4
12th	„	—4—1	600	+1+4
22nd	„	—3—0	600	+4+7

At the end of the first fortnight the optimum amount of air that requires to be introduced varies with the individual under treatment. So also vary the optimum intervals. At the second operation the quantity should be 300 to 400 c.c. and at the third 400 to 500 c.c. If however, there is embarrasment, dyspnoea or pain, smaller amounts, as for example 200 c.c., introduced on alternate days are sufficient. A collapse is thus

attained in from 2 to 4 weeks. Frequency of refillings is now diminished and depends upon the condition of the pleura, the mount of exercise taken and other factors. Ambulant patients absorb air more quickly. A healthy pleura absorbs more air. Our chief guides to indicate the necessity for a refill are the general condition of the patient, and the clinical findings in the chest and on radiological examination.

PRICIPAL MANOMETRIC CHANGES.

A. *Needle in the chest wall.*

- (a) Above the endothoracic fascia.
Manometer at zero.

- (b) In contact with the endothoracic fascia.

Feeble oscillations from zero to 3 cm. on both sides of the manometer but no negative pressure.

- (c) In an intercostal artery.

Slowly rising positive pressure in the manometer.

- (d) In contact with the parietal pleura but not through it.

A slight negative pressure during inspiration becomes less on expiration.

B. *Needle in the pleural Cavity.*

- (a) Free in the lumen.

A negative pressure of 5 to 10 cm. with distinct respiratory oscillations higher in the limb which is connected to the needle.

- (b) Needle either clogged or pushing the visceral pleura in front of it or even in the lung.

Negative pressure of 10 cm. or more, remains stationary and there are no oscillations.

- (c) Needle in the adhesions.

Feeble negative pressure of 2 or 3

cm. and slight oscillations in case of slight and yielding adhesions; manometer at zero or slight oscillations of 1 or 2 cm. and equal on both sides in case of dense adhesions.

A. *Needle in the lung.*

(a) In the consolidated lung tissue
Manometer at zero.

(b) In a bronchus.

No negative pressure but slight oscillations of equal excursions.

(c) In a blood vessel.

No oscillations but a slightly positive pressure. Blood may also enter the needle.

COMPLICATIONS.

1. *Pleural Shock.*

It may occur whether or not the pleura is anesthetized. The anesthetic,

however, renders the procedure painless and gives a sense of security to the operator, and should on this account never be neglected

When the pulse becomes feeble or the patient turns pale or dyspnoeic, a hypodermic injection of adrenaline should be made, the patient made warm with hot water bottles and cardiac stimulants administered. Artificial respiration should not be done because, if the case turns out to be one of gas embolism more air may enter the blood vessel. A great majority of the cases recover quickly.

2. *Gas Embolism.*

This should not occur if the manometric changes are properly appreciated and an injection not made unless the lumen of the needle lies free in the pleural cavity. When it occurs, it is an unfortunate accident and the treatment is the same as that of collapse. Artificial respiration should not be done.

3. *Pleurisy with Effusion.*

It develops in approximately 50 per cent of the cases. Burrel summarizes its treatment as follows:—

(a) “Rest in bed during the febrile stage and symptomatic treatment.

(b) Avoid aspiration if possible, but take a sample of liquid and make an x-ray examination every 3 months to see that the liquid remains clear.

(c) When aspirating more than 15 oz. always replace the liquid with air or oxygen. Air should be used if it is proposed to maintain the pneumothorax and oxygen if it is intended to let the lung re-expand.

(d) Gas replacement should be done if:—

(i) The effusion is causing dyspnoea or discomfort from displacement of the mediastinum.

- (ii) It is thought that the lung has been collapsed long enough and it is decided to terminate the pneumothorax treatment.
- (iii) There is an acute spread of disease in the other lung.
- (iv) The effusion becomes purulent.
- (e) Oleothorax may be employed if the pneumothorax cavity is becoming obliterated by contraction of adherent pleura."

When the effusion becomes purulent Oleothorax and gelatinothorax are also recommended.

4. *Surgical Emphysema.*

This may develop from injection of air extrapleurally between the endothoracic fascia and the pleura, from injury to the lung or as a result of coughing.

5. *Ruptured Lung.*

There is severe pain as after